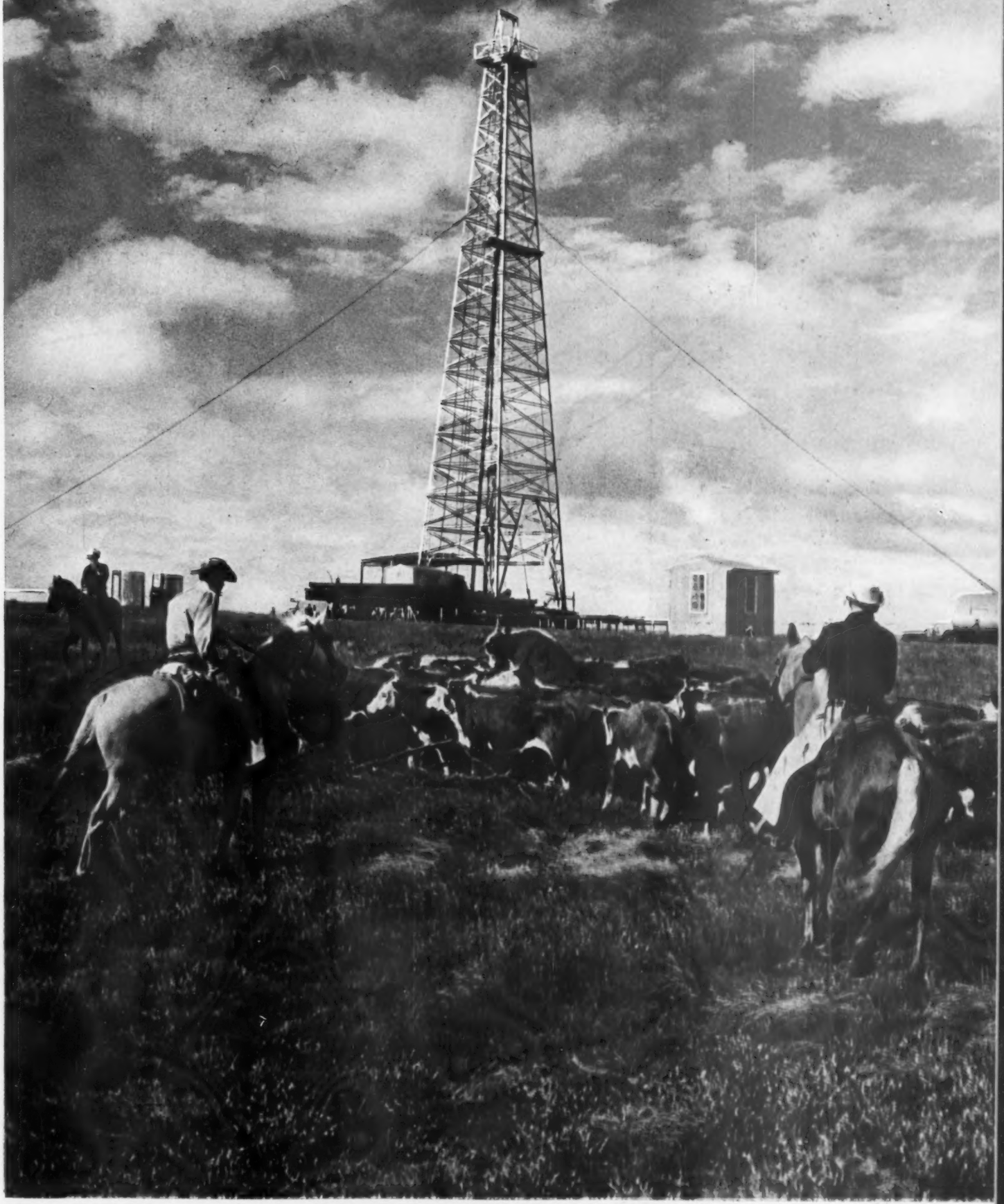
World Petroleum



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CENTS
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MARCH, 1950

LEADING REFINERS BLEND

With WARREN'S *Stabilized*

NATURAL GASOLINE *and* STA-VOL-ENE

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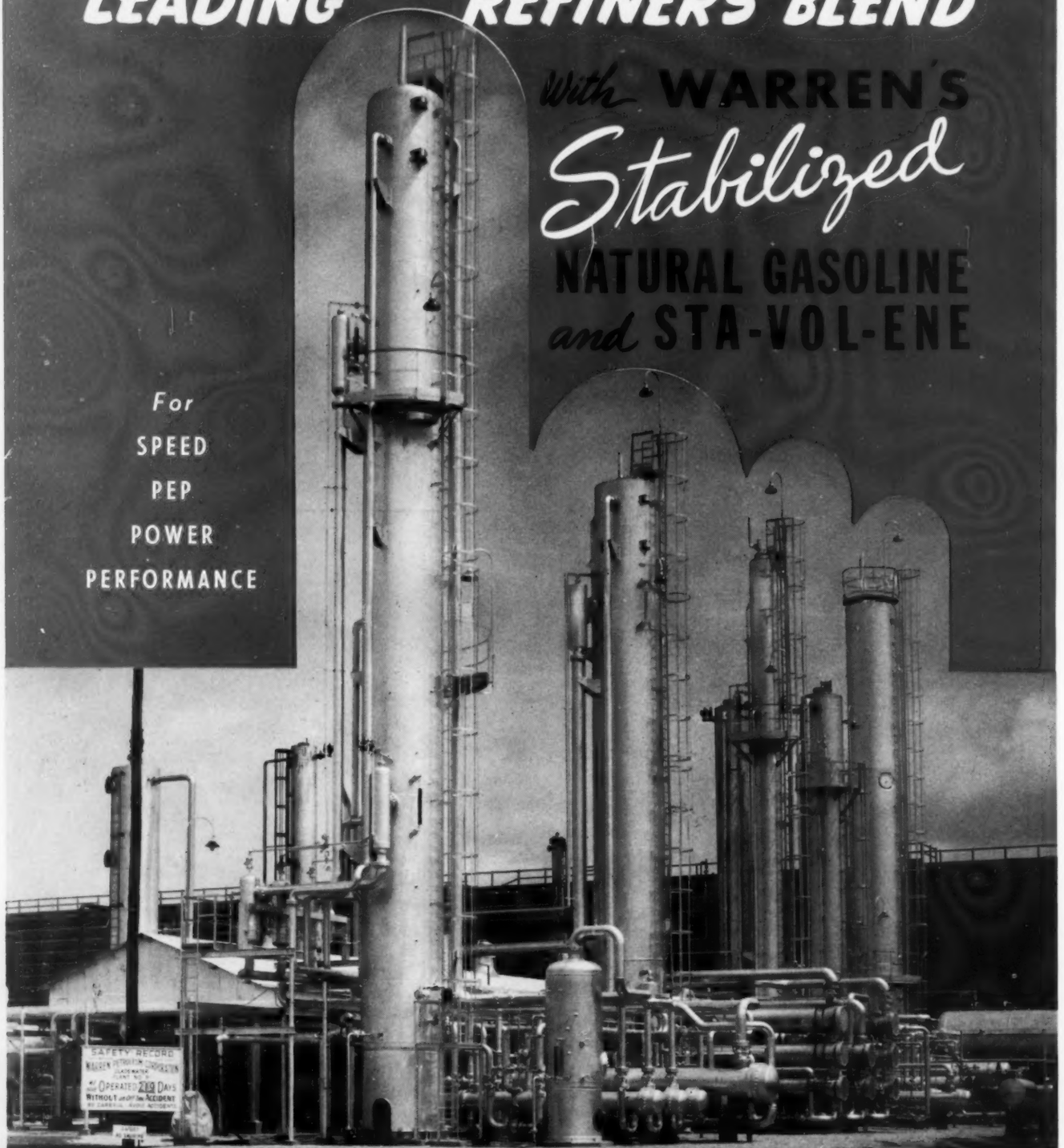
PEP
POWER
PERFORMANCE

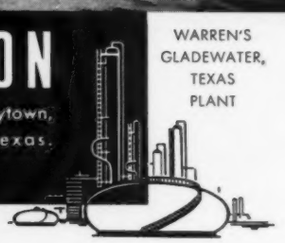


WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

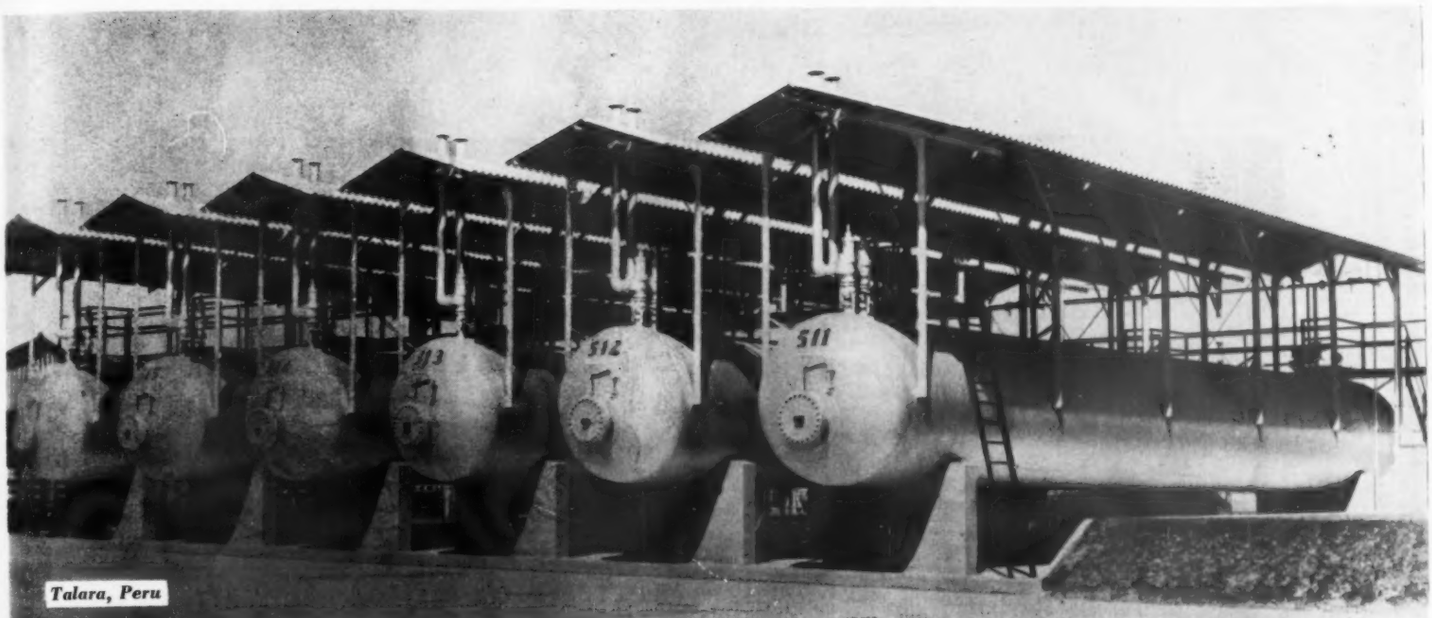
Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

TULSA 2, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren



WARREN'S GLADEWATER, TEXAS PLANT

Crude Oil, Natural Gasoline and Liquefied Petroleum Products



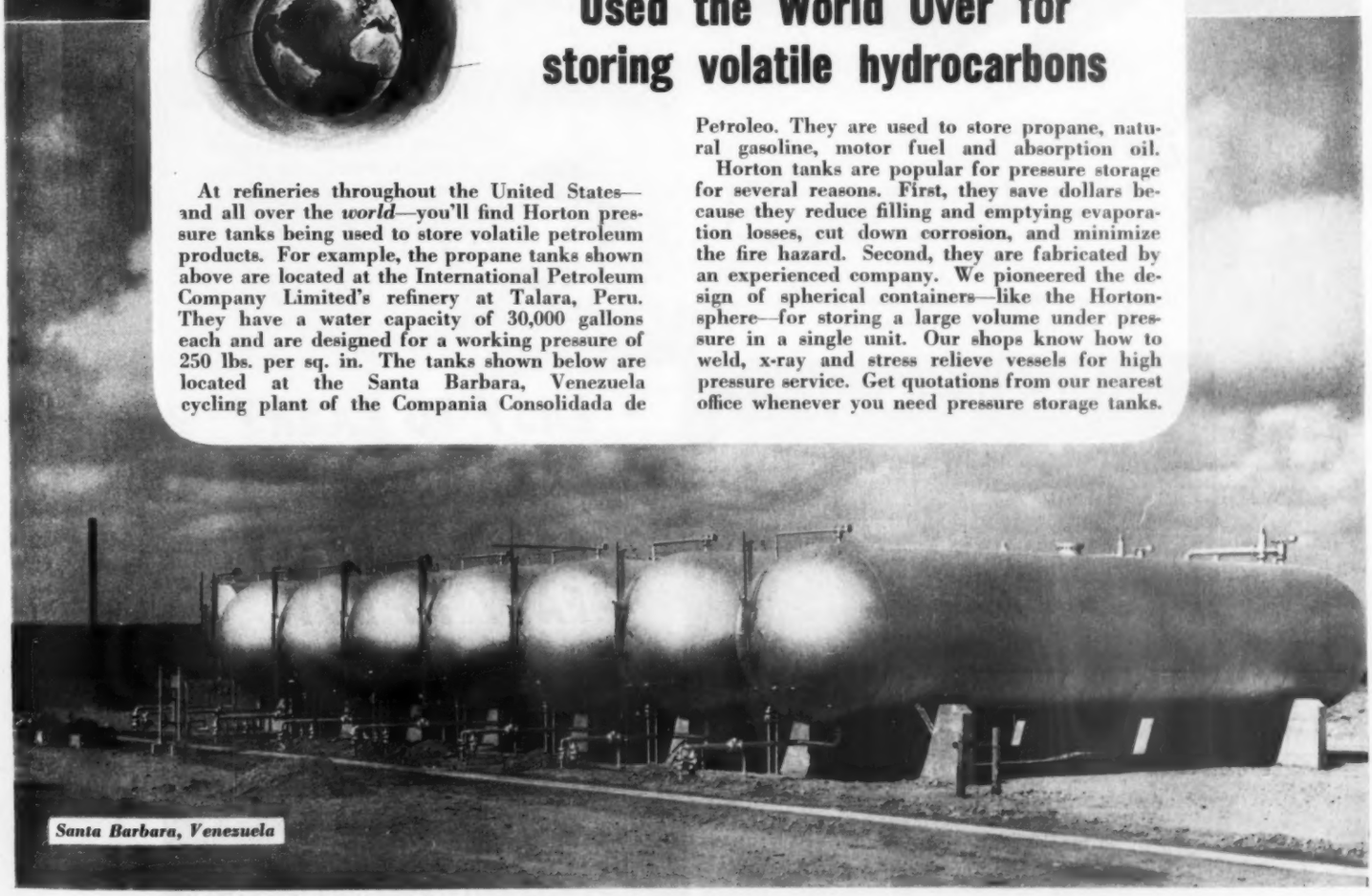
Talara, Peru

Horton Pressure Tanks

Used the World Over for storing volatile hydrocarbons

At refineries throughout the United States—and all over the *world*—you'll find Horton pressure tanks being used to store volatile petroleum products. For example, the propane tanks shown above are located at the International Petroleum Company Limited's refinery at Talara, Peru. They have a water capacity of 30,000 gallons each and are designed for a working pressure of 250 lbs. per sq. in. The tanks shown below are located at the Santa Barbara, Venezuela cycling plant of the Compania Consolidada de Petroleo. They are used to store propane, natural gasoline, motor fuel and absorption oil.

Horton tanks are popular for pressure storage for several reasons. First, they save dollars because they reduce filling and emptying evaporation losses, cut down corrosion, and minimize the fire hazard. Second, they are fabricated by an experienced company. We pioneered the design of spherical containers—like the Hortonsphere—for storing a large volume under pressure in a single unit. Our shops know how to weld, x-ray and stress relieve vessels for high pressure service. Get quotations from our nearest office whenever you need pressure storage tanks.



Santa Barbara, Venezuela

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NOW it's a fact!

A PORTABLE-PRACTICAL GEO-LOGGER

THE ELECTRIC WELL-LOGGING UNIT

that is

RUGGED, OPERATOR-PROOF, LOW COST, FAST and ACCURATE

GEO-LOGGER

cuts the cost of information out of every shot or core hole of 1500 feet or less. After two years of development and testing, the portable, operator-proof Geo-Logger is ready to save you time and money. OK'd for design, performance and results by geologists and geophysicists who have seen Geo-Logger in operation.

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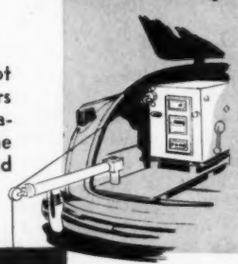
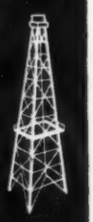


No extra vehicle: Geo-Logger is compact, fits inside trunk compartment of any average passenger car, can be mounted on shooting truck or pick-up. Single aluminum case 18" high, 26" long, 14" wide. Powered by extra belt-driven generator, under hood of car or truck, just above regular generator.

SAVE PERSONNEL, TIME, MONEY



No extra man: Geo-Logger can be set-up and log made by one member of drilling crew. **No extra time:** Geo-Logger gets log of average shot hole (200 feet) in less than 5 min. elapsed time, from start of set-up to out of the hole and out of the crew's way. On a 700-ft. strat test—20 min. elapsed time.

- *EASY TO CARRY*
- *EASY TO USE*
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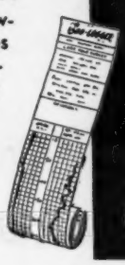
ACCURATE, LOW-COST LOGGING COMPARABLE TO SERVICE COMPANY RESULTS!

The Geo-Logger gives you electric logs showing resistivity and self potential curves in holes up to 1500 feet; accuracy in every way comparable to service company logs, obtained at a fraction of their cost. Aids in picking proper position for shot, serves the interpreter of seismic records and locates water supplies for operating departments. The Geo-Logger will stretch current logging budgets; will make possible logging that, heretofore, could not be afforded.



GEO-LOGGER is available now, for sale or lease. Simple, rugged, self-contained, weather-resistant; saves you transportation, men, time, MONEY. For further information, performance records, specifications, write today.

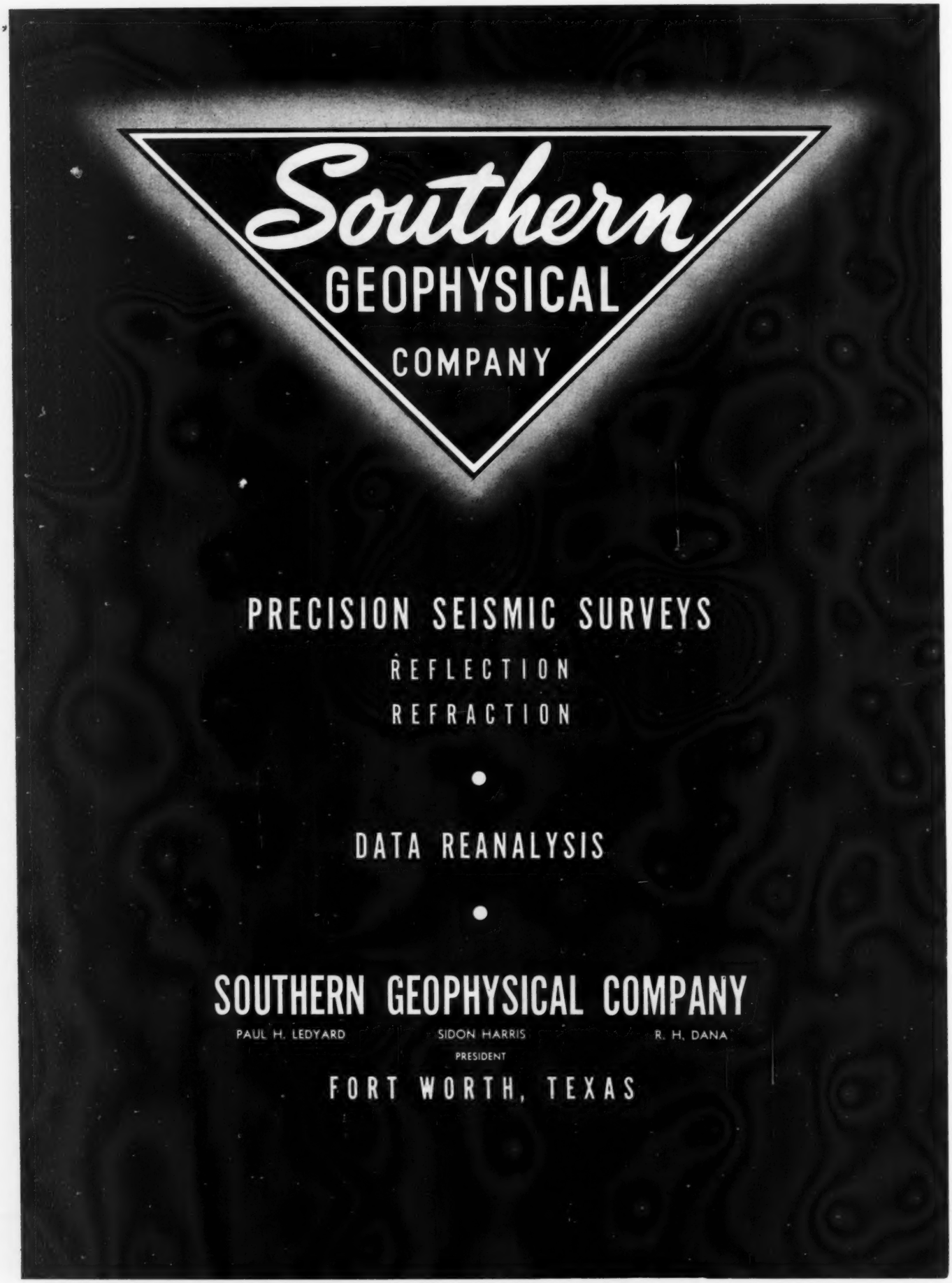
Manufactured by

GEOTRONIC LABORATORIES, INC.

DALLAS, TEXAS

THE FRONTIER REFINING CO.
RARIN' TO GO
DENVER, COLORADO
CHEYENNE, WYOMING
Chooses
REFINERY ENGINEERING COMPANY
to Design, Engineer and Build their new
Cheyenne, Wyoming Cracking & Coking Units
This will consist of a 2-coil UOP Thermal Cracking Unit with integral coking facilities; a charging capacity of 2400 barrels and producing 105 tons of petroleum coke per day. The unit will also have a charging capacity of 3500 barrels, producing 1560 barrels of railroad fuel oil daily. Wyoming 19 gravity reduced crude will be used as charging stock. All hot oil lines, internal surfaces of vessels, pumps and other auxiliary equipment subject to corrosion will be fully alloy protected.
The Frontier Refining Company is taking the lead in the Rocky Mountain area in establishing a full-rounded schedule of operations. Starting date was December 1, 1949 and estimated completion date is late spring of 1950.
TRECo
REFINERY ENGINEERING Company
PHONE 5-5561 • TULSA, OKLAHOMA

WORLD PETROLEUM for March, 1950. Vol. 21, No. 3, March, 1950. WORLD PETROLEUM is published monthly by Mona Palmer, Trustee under the will of Russell Palmer, 2 W. 45th St., New York 19, N. Y. Acceptance at East Stroudsburg, Pa., under Section 34.64 P. L. & R. Authorized. Subscription rate: $5.00 per year, single copies 50c.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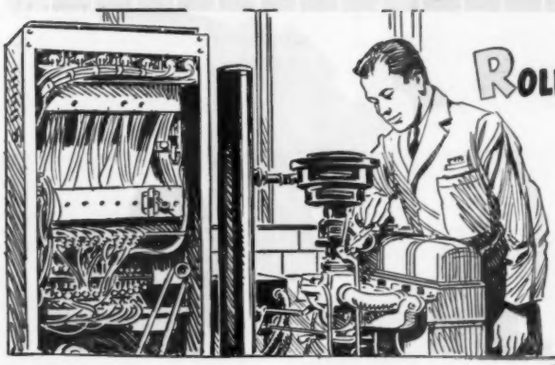
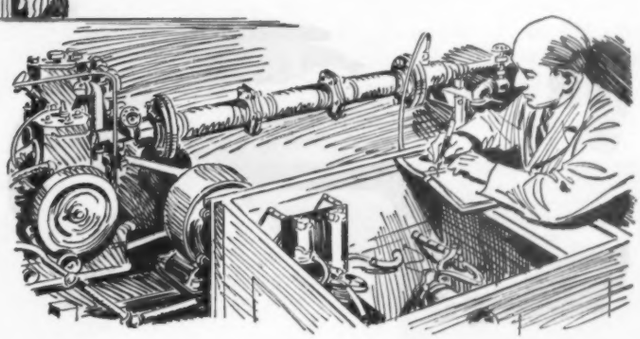
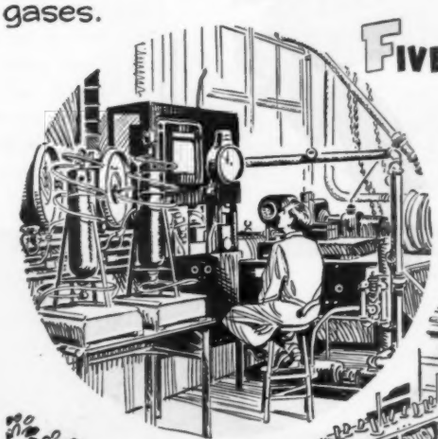
Technically Speaking... by ETHYL



ROLLED-UP HIGHWAY. This special Ethyl equipment-designed on the principle of a **PLAYER PIANO**—uses a perforated tape to control engine speed and torque... simulating indoors the variations found in road service.



TRAPPING THE INVISIBLE. In the development of antiknock compounds Ethyl uses a Cottrell precipitator to trap all solid particles--many of them invisible--in engine exhaust gases.



FIVE MAJOR IMPROVEMENTS in "Ethyl" antiknock compound have resulted from Ethyl's intensive and expanding research program.

146 "CLEANLINESS" RATINGS are made on 83 engine parts after each test run... in research to show the effects of different fuels, lubricants, and additives on engine cleanliness.

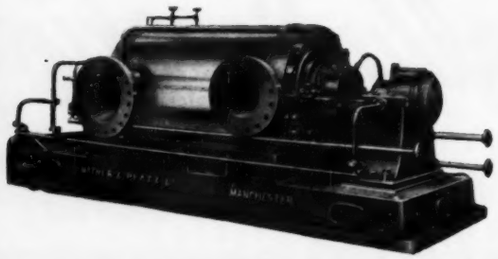
Since 1923—*continuous research to provide better antiknock service*

ETHYL CORPORATION
RESEARCH LABORATORIES
Detroit, Michigan, 1600 West Eight Mile Road • San Bernardino, California, 2600 Cajon Road

ETHYL ANTIKNOCK COMPOUNDS — ETHYL CORPORATION

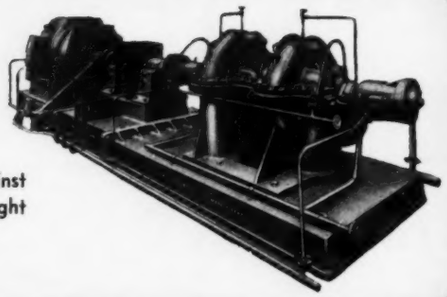
Centrifugal Pumps & FLAMEPROOF MOTORS

Main Pipeline Pumps....



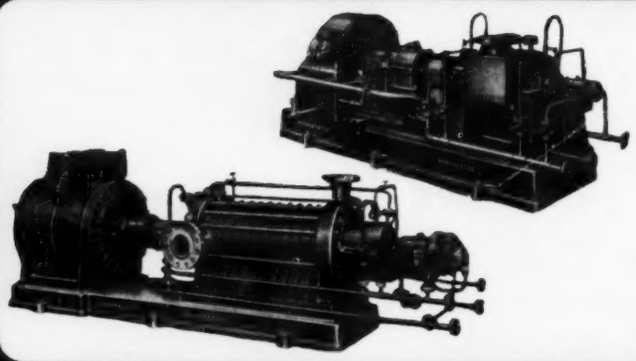
Mather & Platt multi-stage 'Plurovane' pumps were amongst the earliest centrifugal pumps installed for main line work. The pump shown on the left is a typical modern 'Plurovane' designed for a throughput of 50,000 bbls/day of crude oil against a pressure of 750 p.s.i. when running at 1500 r.p.m.

Transfer and Loading Pumps



Our standard ranges include a pump for nearly every transfer or loading duty. The two-stage "Medivane" pump illustrated on the right can handle 700 tons/hr. of crude or products against heads up to 500 ft. It is driven through a gas tight wallbox by a 550 h.p. Mather & Platt Motor.

Refinery Process Pumps



Our long refinery experience at home and abroad enables us to supply pumps for the most arduous refinery duties. The illustration shows typical units:—a steam turbine driven pump handling oil at 500 degs. F. and a motor driven "Plurovane" pump dealing with light volatile hydrocarbons.

Flameproof Motors on Pipeline Duty....

Mather & Platt electrically-driven centrifugal pumps on an oil pipe line. The motors here illustrated are of the totally enclosed flameproof type, and are of 1,000 h.p. capacity, fed from a 3 phase 50 cycle 6000/6600 volt supply. They are squirrel cage direct-on started machines with a starting current of four times full load value.

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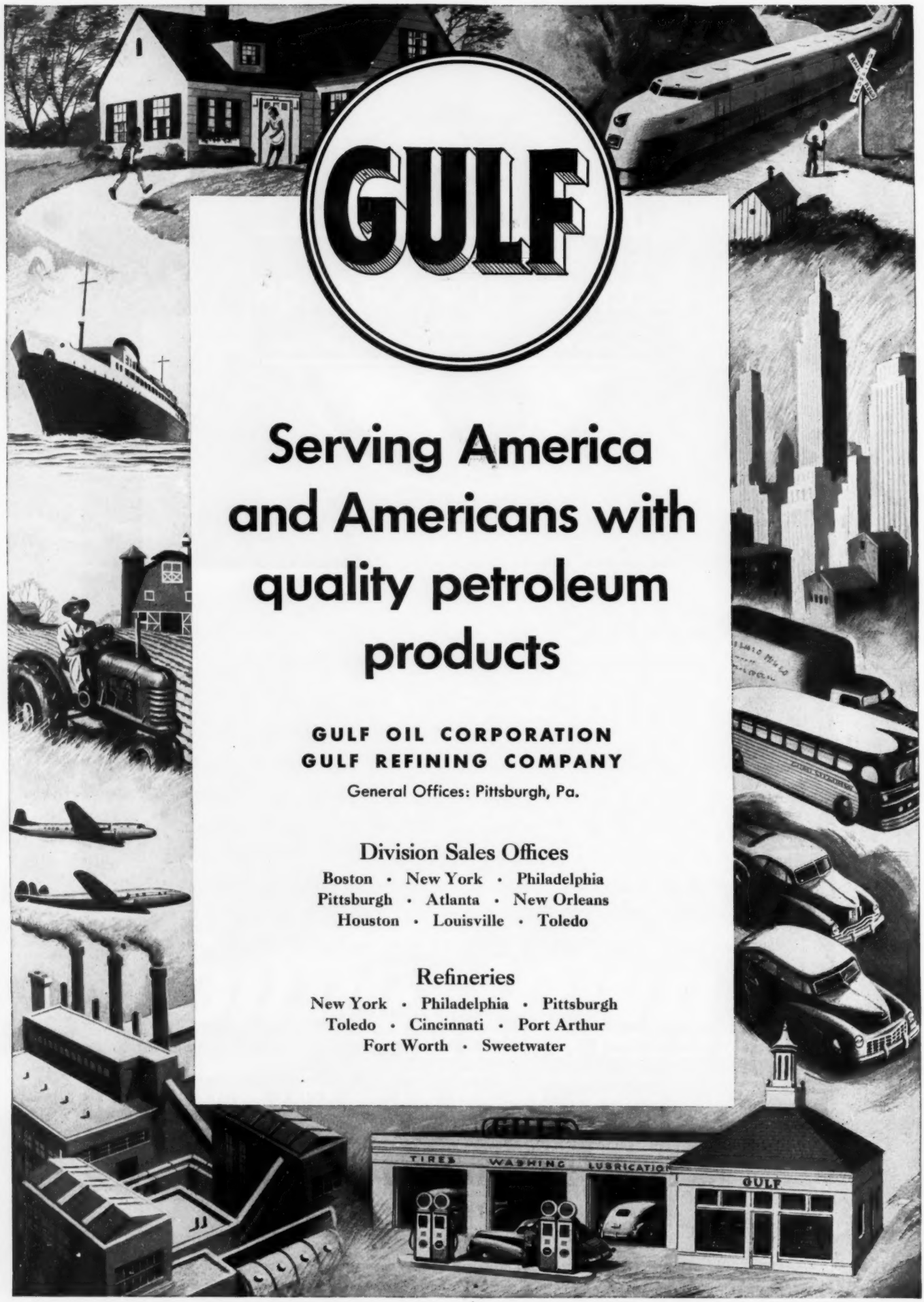
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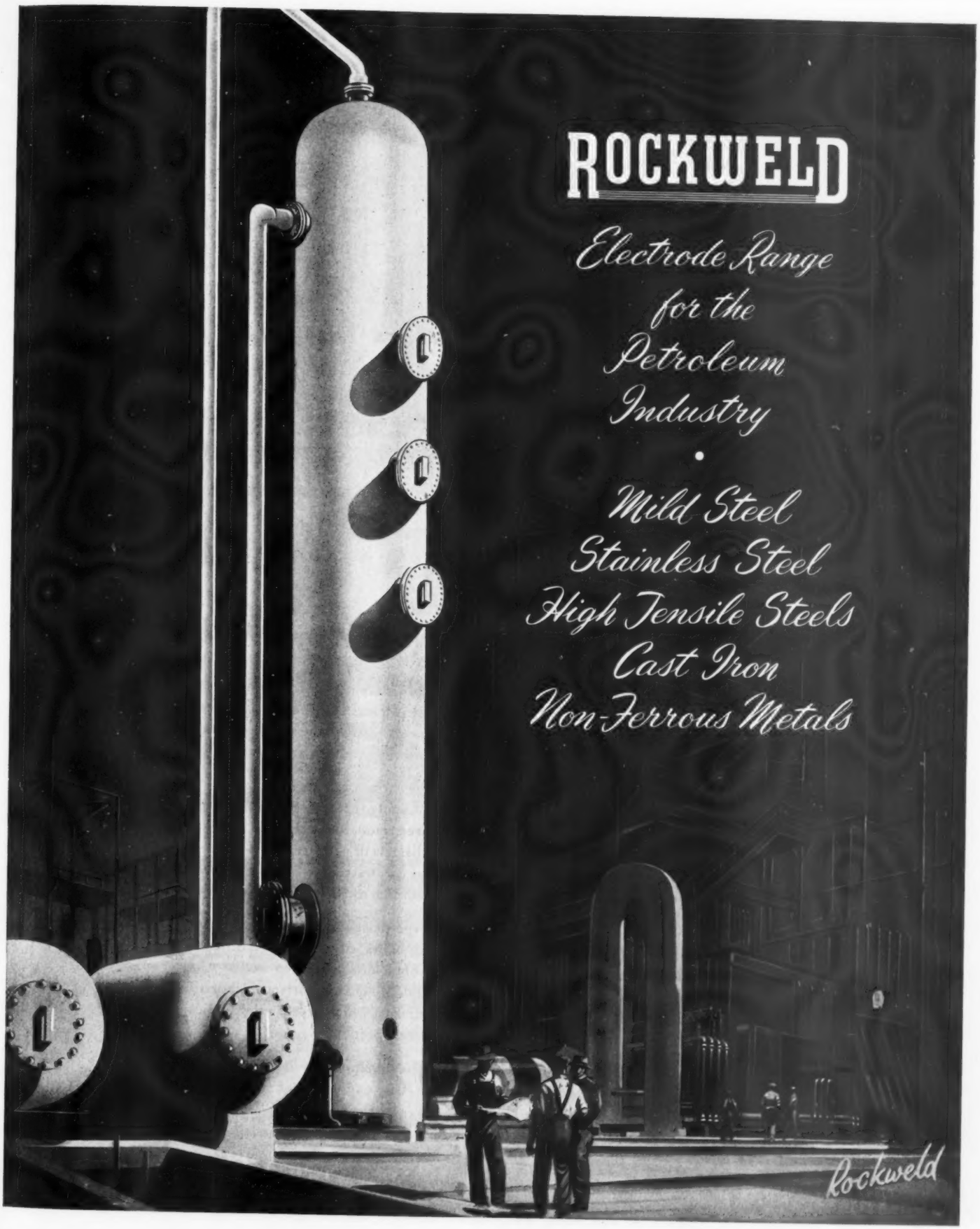

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It is all the more significant, then, that Attapulgus Fullers Earths and Porocel Activated Bauxites have become recognized standards in the field of adsorbents. As of now, at least a billion barrels of petroleum cuts—from the lightest distillates to the heaviest lube and wax fractions—have been treated by Attapulgus or Porocel materials to gain remarkable finished value.

This all adds up to a lot of specialized experience—intimate acquaintance with the process techniques for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from hydrocarbons, as well as for systems employing solid catalysts. And, of equal importance, laboratory and plant experience with the many treatments which precede the application of our two basic materials to specific adsorbent jobs.

Perhaps our broad knowledge can be of real help to you in selecting the right adsorbent and the right conditions. Our staff is at your service, without obligation.

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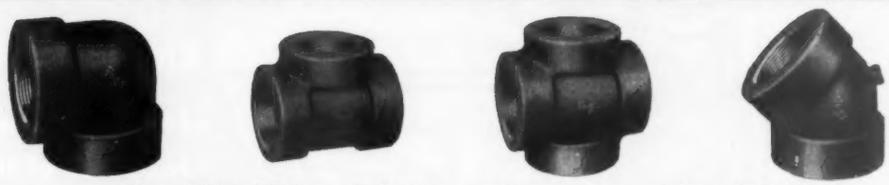

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For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

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Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

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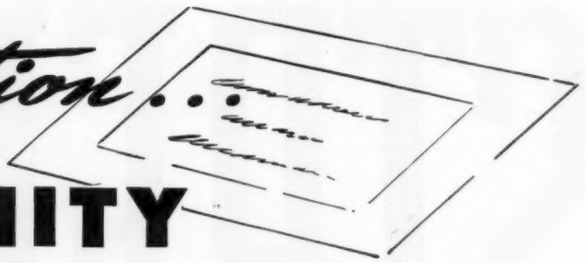

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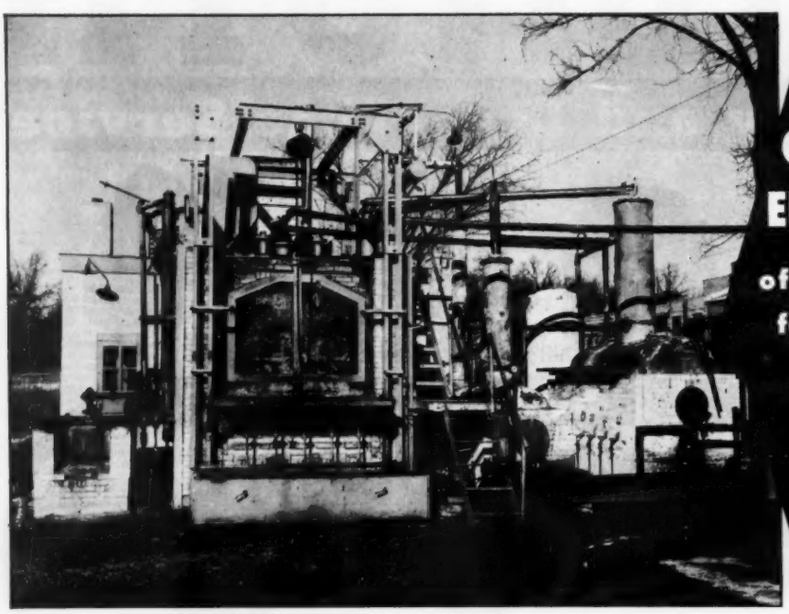

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THE IMPROVED DRILLING MUD STARCH

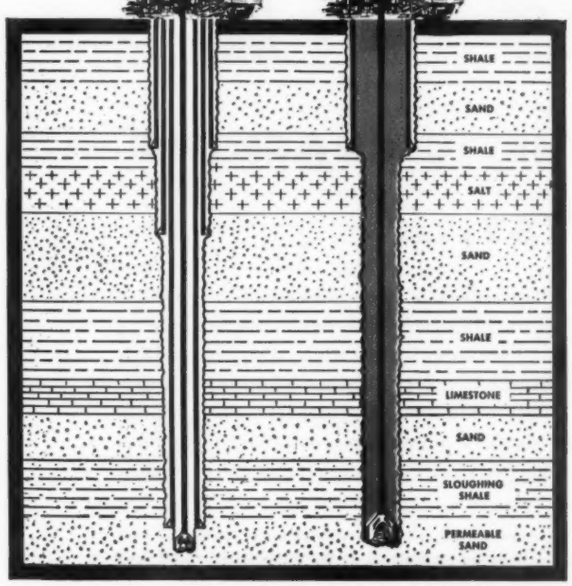
can take the place of protective strings

Quick acting, tough, economical My-Lo-Jel provides positive control of filtration properties.

Magcobar My-Lo-Jel is an improved pregelatinized drilling mud starch in the form of a free flowing powder which can be added directly to the mud through a hopper mixer. My-Lo-Jel provides positive control of the filtration properties of mud even in the presence of salt, anhydrite and other contaminants. It is a blended starch that is especially processed to produce a quick acting, tough and chemically stable plugging agent to inhibit filtration of mud. Thus, it not only lowers water loss, but keeps it low.

My-Lo-Jel is economical and easy to use. So why take chances with tight holes due to filter cake when low water loss muds made with My-Lo-Jel can hold down the cost of drilling by eliminating strings of protective casing, preventing delays due to reaming, hole trouble and fishing jobs.

Look for the Magcobar sign when you need mud!



The well on the left is an example of where two additional strings of protective casing were necessary — one to protect a zone of rock salt and the other to protect a sloughing shale. My-Lo-Jel Mud eliminated the necessity for this extra casing.

Look for this sign **WHEN YOU NEED MUD**

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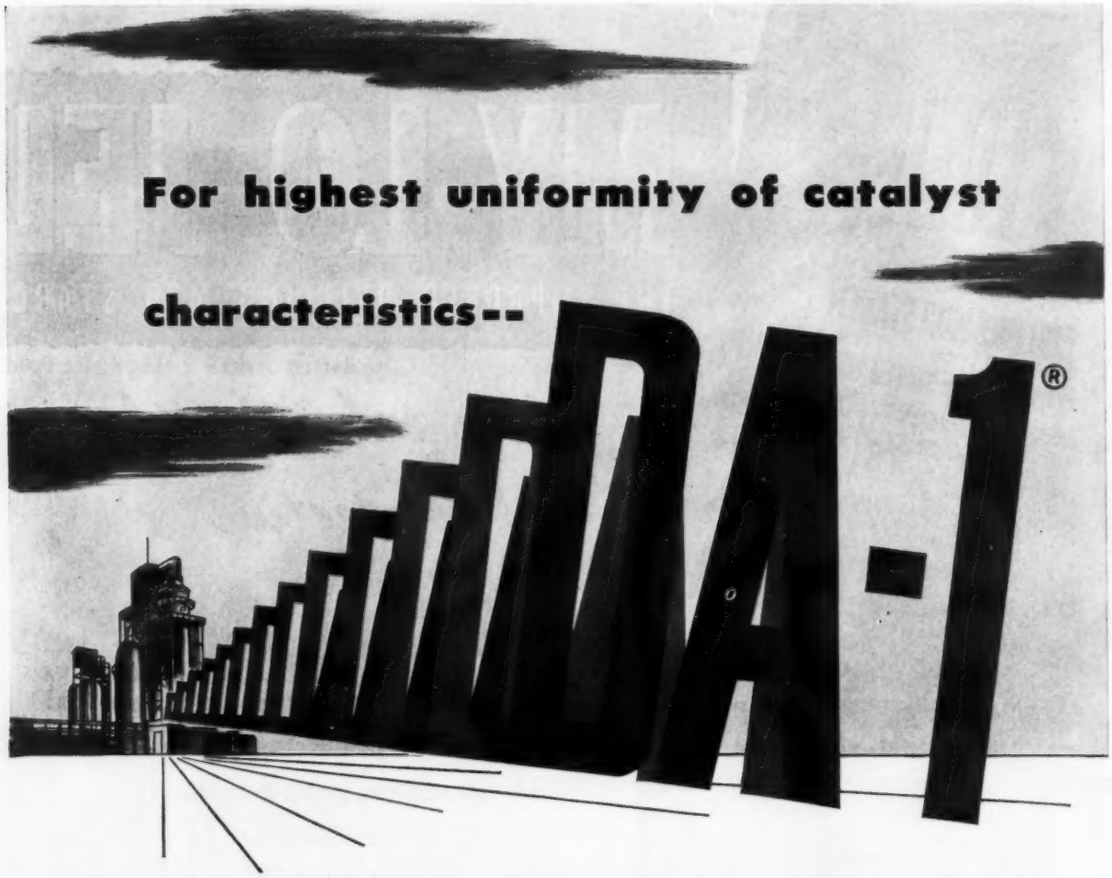
Magcobar

Complete

DRILLING MUD SERVICE

DEALER



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For special processes, Davison can place at your service an experienced staff and a modern, new plant devoted exclusively to the development and production of custom catalysts in granulated, powdered or pelleted form.

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EXPERIENCE—You receive the benefits of our experience as the oldest producer of fluid synthetic cracking catalysts.

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TECHNICAL PAPERS *and* ARTICLES

by

FLUOR RESEARCH *and* ENGINEERING PERSONNEL

Indicate the Subject by Number

"Fractionating Absorbers in the Petroleum Industry"

By: J. C. HANNAH, *Process Engineer*

Abstract: *Rapidly changing conditions necessitate familiarity with all methods now in use in the petroleum industry for separating mixtures of low-boiling hydrocarbons and associated compounds in order to obtain the most economic method for a given gas recovery and/or purification problem. This paper discusses one of these methods, i.e., fractionating absorbers. An example of application to actual plant data is shown.*

"Pulsation Phenomena in Gas Compression Systems"

By: I. C. BECHTOLD, *Director of Research and Development*

Abstract: *Pulsation phenomena in gas transmission lines leading to and from gas compressor stations are described along with a description of the mechanical vibration induced from the pulsative flow.*

"Effect of Pulsation on Gas Measurement"

By: C. F. YATES, *Research Engineer*

Abstract: *This paper discusses the effect of pulsative flow on the accuracy of measuring gas-flow rate by orifice meters. Data are presented showing the relationship between magnitude and nature of the pulse and the resultant readings recorded by the measuring instrument.*

"Simultaneous Determination of Hydrogen Sulfide and Carbon Dioxide in a Continuous Gas Stream"

By: C. L. BLOHM, *Assistant Director of Research, and* F. C. RIESENFELD, *Research Chemist*

Abstract: *A method is described for the simultaneous determination of hydrogen sulfide and carbon dioxide in a continuous stream of natural gas. The two acidic gases are absorbed in standardized iodine and barium hydroxide solutions. Only simple laboratory equipment is required.*

"Mechanical Vibration of Piping Induced by Gas-Pressure Pulsations"

By: R. C. BAIRD, *Research Engineer, and* I. C. BECHTOLD, *Director of Research and Development*

Abstract: *The generation and nature of gas-pressure pulses from reciprocating compressor action are described, together with the propagation of such pulses through pipe lines. The means whereby pulse energy is converted to mechanical vibration is discussed by the aid of analogous mechanical, acoustical, and electrical oscillatory systems. The economic importance of minimizing vibration in compressor and compressor-dependent installations is indicated.*

"A Critical Analysis of Methods of Determination of Water Dew Point in Hydrocarbon Gases"

By: F. C. RIESENFELD, *Research Chemist, and* H. D. FRAZIER, *Research Chemical Engineer*

Abstract: *The authors have found that the values obtained from conventional dew point determination apparatus do not give true results when used on gases effluent from liquid dehydrators. A theoretical explanation for this phenomenon and a description of a method for determining the absolute water content of gases from this type of dehydrator is offered.*

"Purification and Dehydration of Gases"

By: C. L. BLOHM, *Assistant Director of Research, and* W. F. CHAPIN, *Process Engineer*

Abstract: *This paper covers the chemistry and chemical engineering of regenerative processes for removing hydrogen sulfide and carbon dioxide from gases by use of amine processes together with their simultaneous or subsequent dehydration. In addition there is presented a description of the engineering features and operation of the Glycol-Amine plants which treat gas transported through the Texas-California line.*

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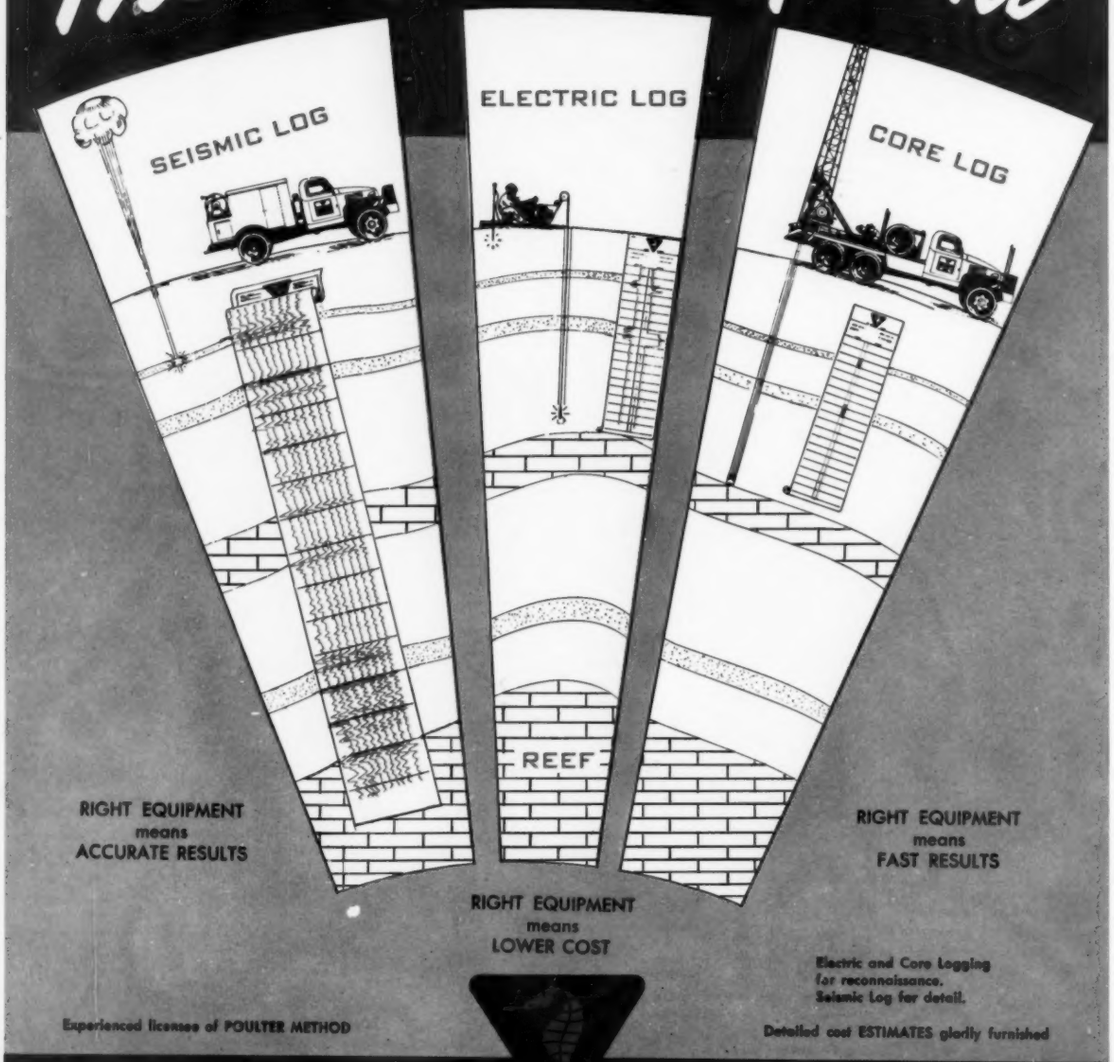

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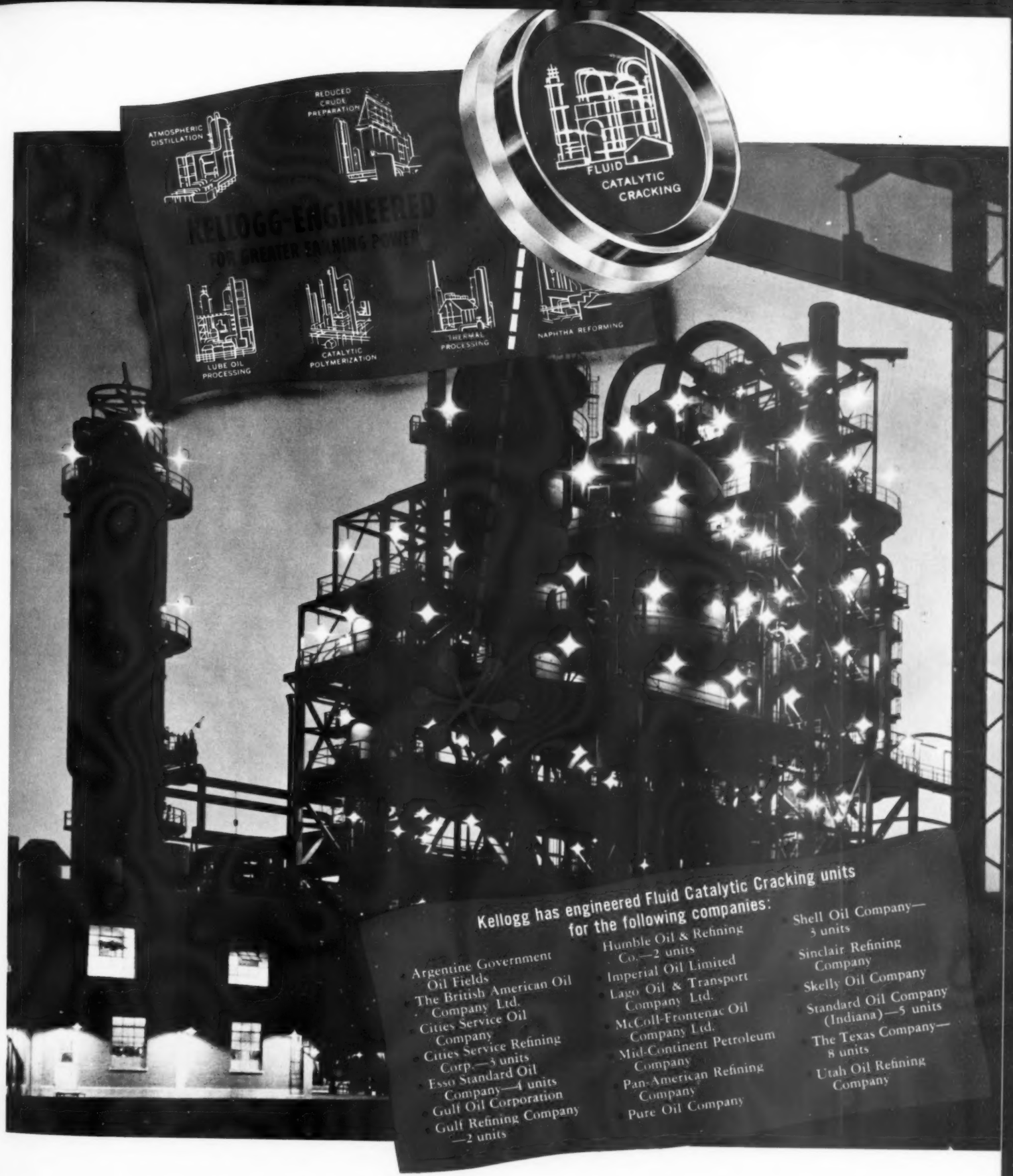

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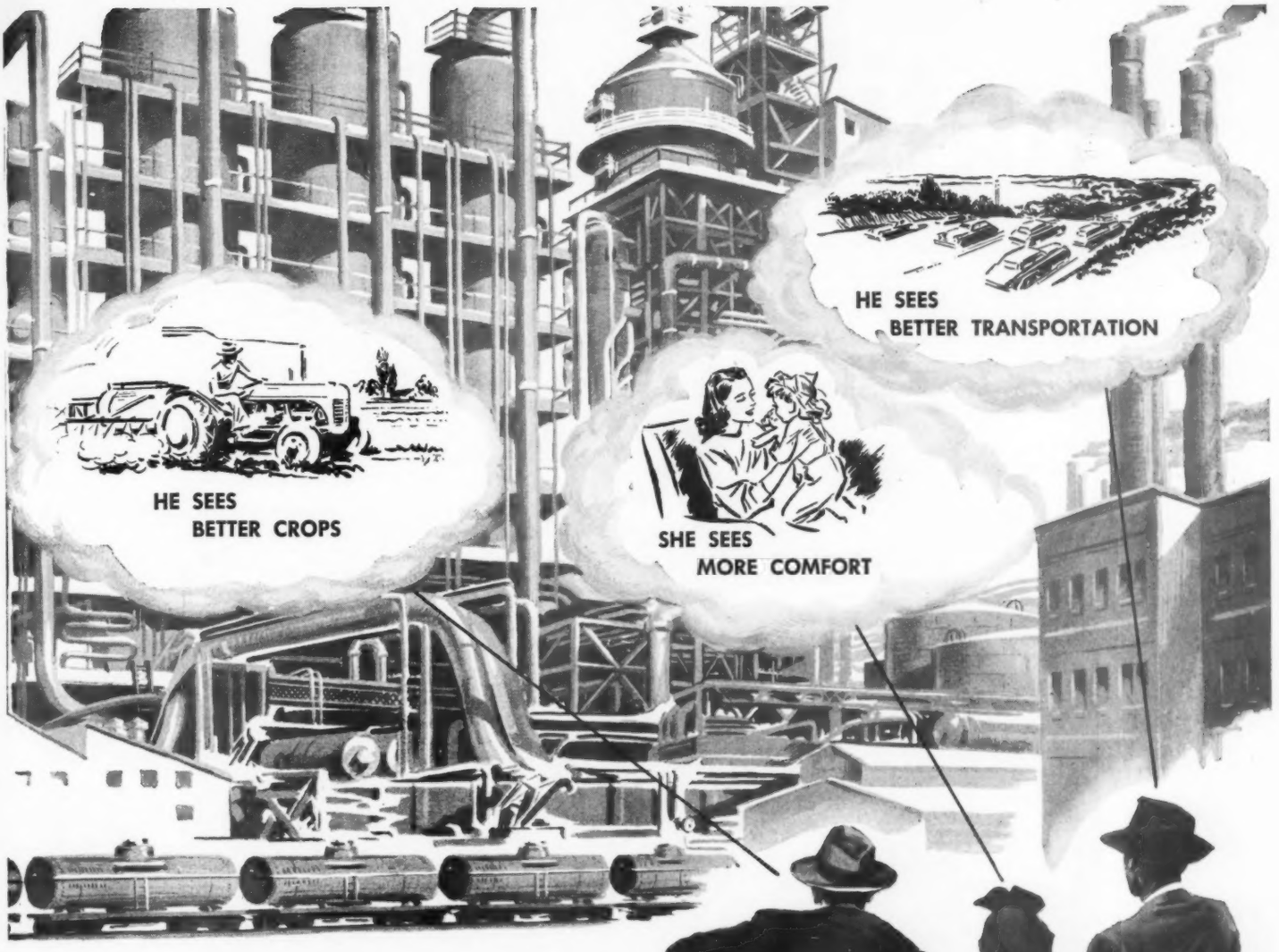

Three Views of a New Refinery

To the oilman a refinery is steel, pipe, brick, mortar, pumps and controls. It is his job to make these produce oil products that make for a better way of life at the lowest possible cost to the consumer.

If you are a farmer it means bigger and better crops with better weed killers; constantly improved fuels and lubricants for trucks and farm machinery. And it means healthier, more productive livestock with effective petroleum insecticides.

If you are a housewife it means the comfort and convenience of modern heating and cooking . . . the lasting protection of better paints and preservatives . . . more efficient operation of the family car with modern gasolines and motor oils . . . health protection with new and better insecticides.

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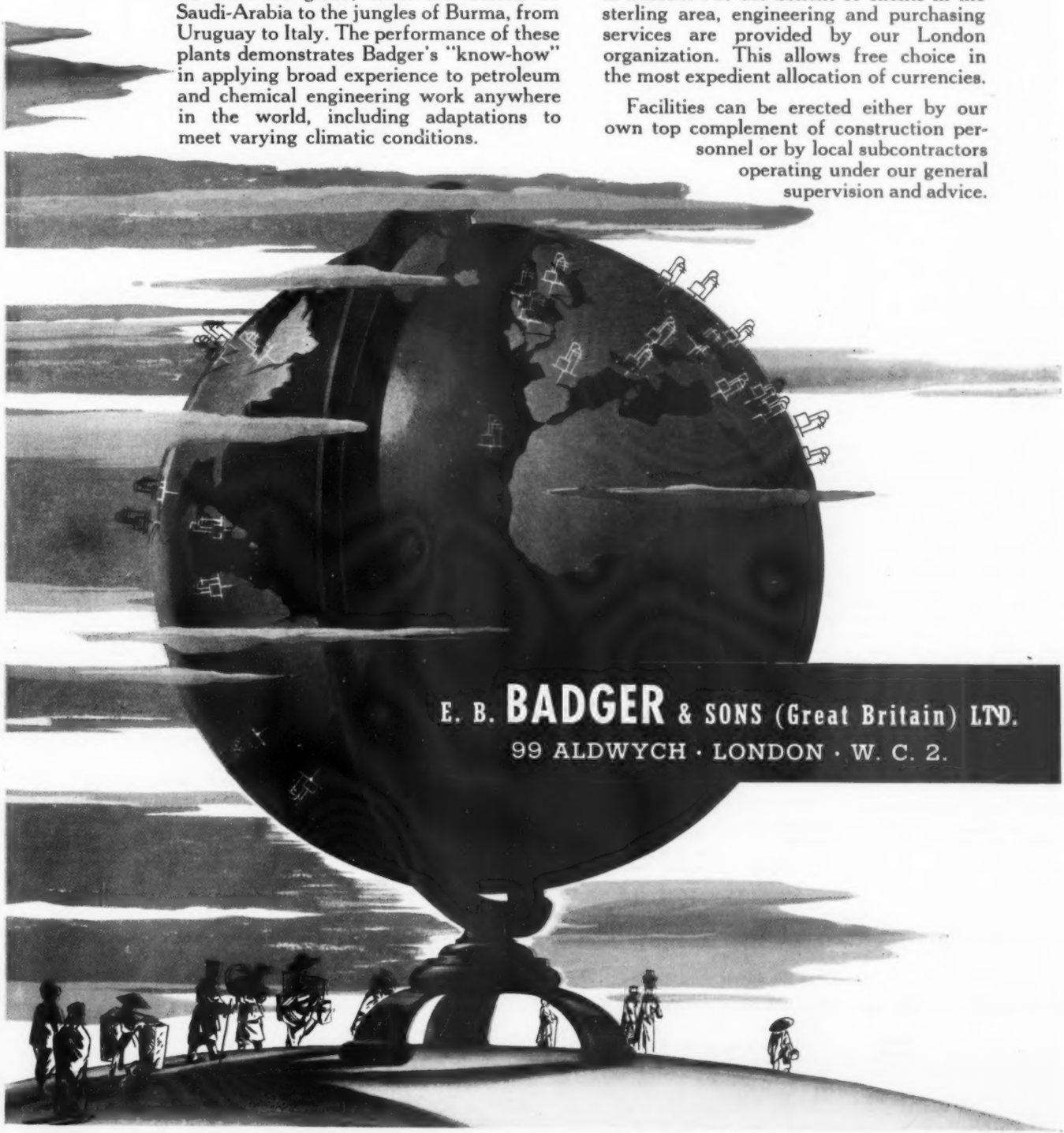

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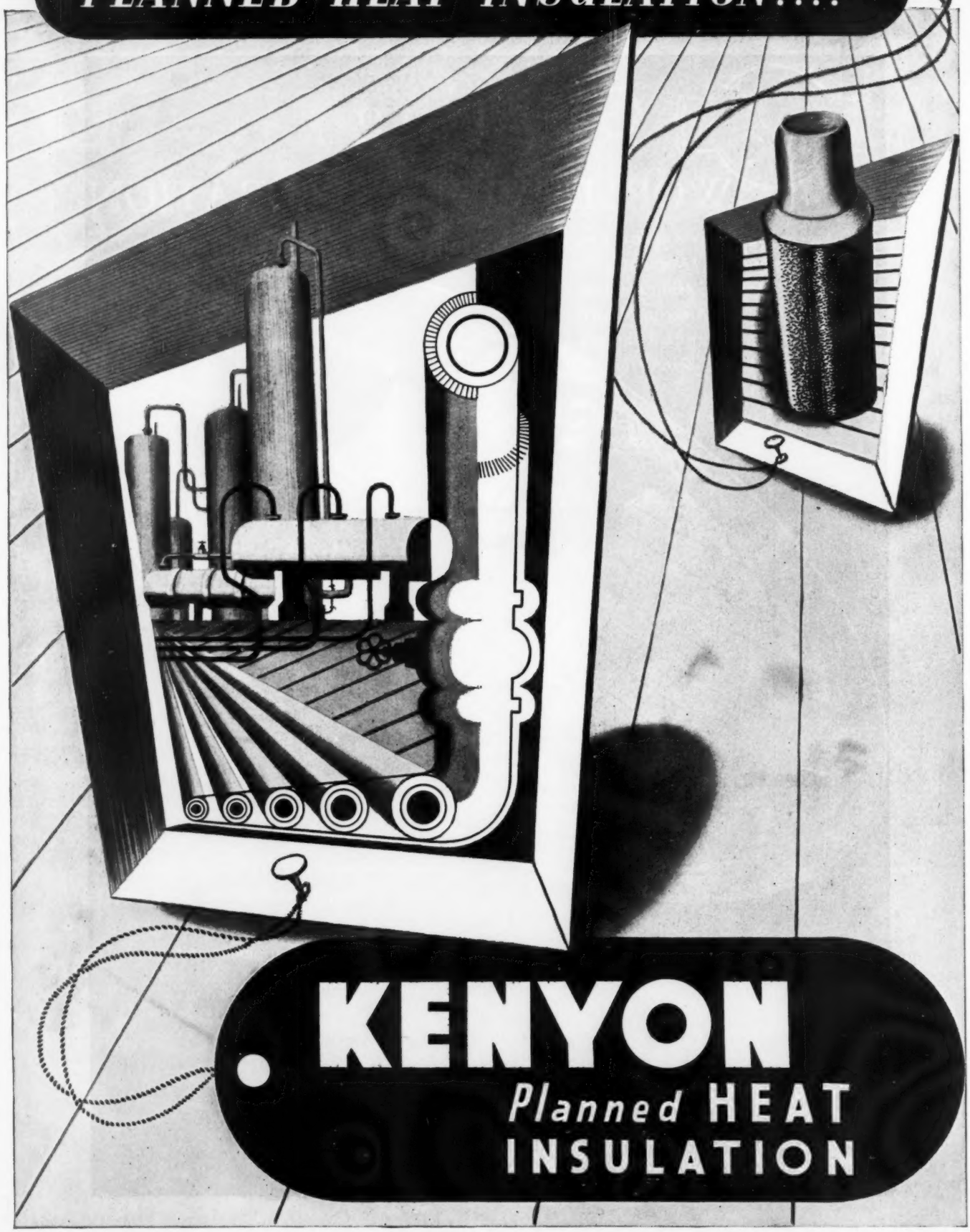

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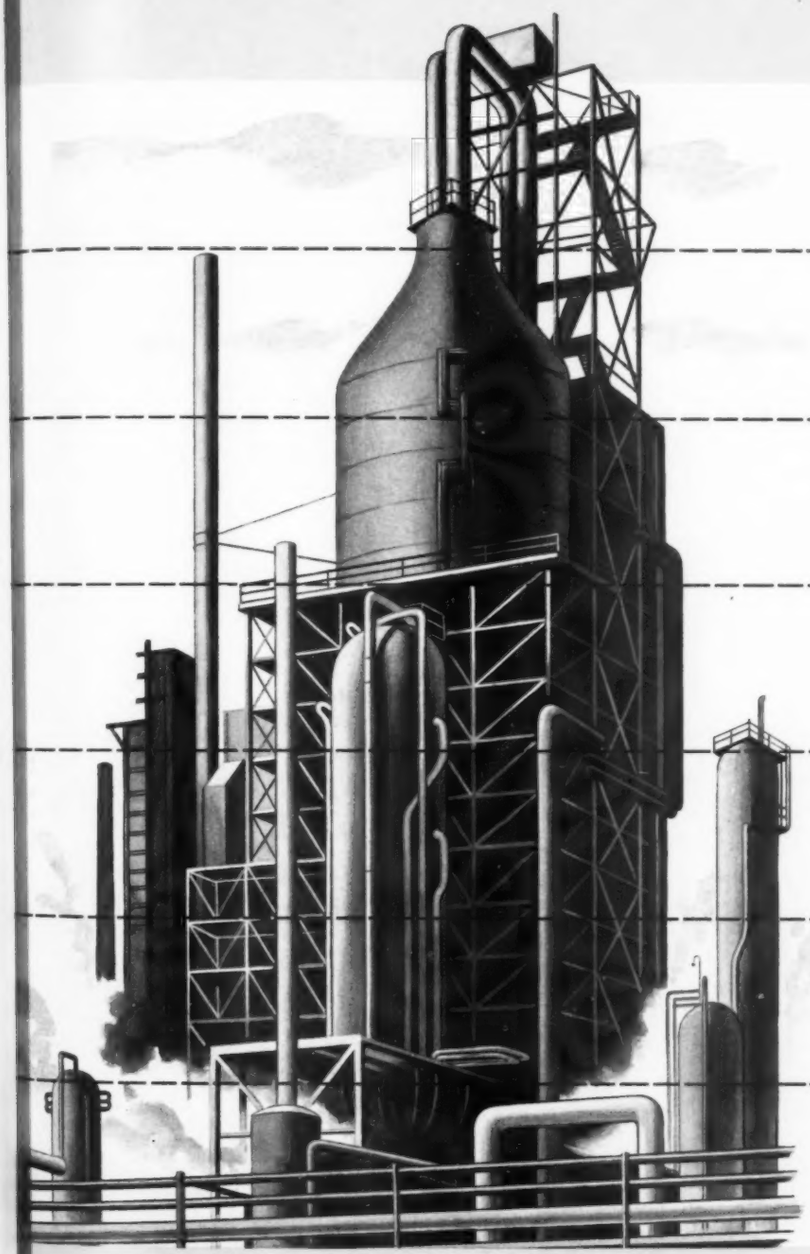

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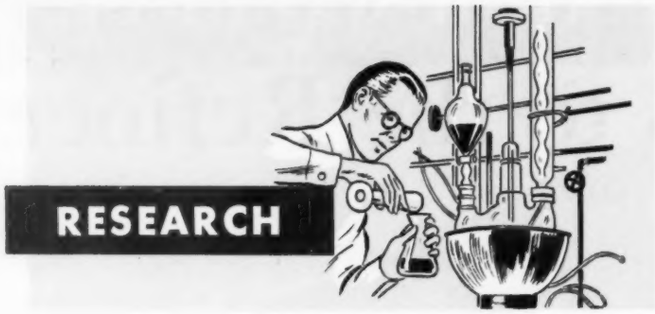


What petroleum chemicals research facilities does Du Pont have?

Du Pont maintains a complete research department devoted to the study of fuels and their components, both from a chemical and an engineering standpoint. Center of the Petroleum Chemicals research effort is at Deepwater, New Jersey. Road test fleets operate out of this headquarters as well as out of the El Monte, California Road Testing Laboratory.

What other research facilities does Du Pont have?

In addition to the research carried out in the Petroleum Chemicals laboratories, specific projects are maintained in the company's experimental station for which a new $30,000,000 building project is nearing completion in Wilmington. The findings of other laboratories throughout the company are available at all times for consideration as to their application to the petroleum industry.

What are the objectives of Du Pont Petroleum Chemicals research?

Du Pont has initiated a long-range program of fundamental research leading to a better understanding of the combustion process and its chemical control. A wide variety of studies are under way to help refiners utilize present TEL compounds most efficiently. Others are aimed at improving antiknock compounds. Research is also conducted on other gasoline additives.

What Technical Service does Du Pont offer?

Du Pont provides an integrated technical service that works with refiners, equipment manufacturers and fuel users.

Does their work treat with refinery operation?

Du Pont's men are fully trained in the various phases of refinery work and are able to consult with your management, research and development groups, not only upon problems related to the most efficient utilization of TEL Compounds, but also upon refining and treating processes that relate to the use of additives.

Is Du Pont prepared to offer further technical services?

Du Pont Technical Representatives will keep you advised on the latest technological developments in the refining and additives field and will work with you toward their incorporation into your own processes. They will also assist in training personnel in precision test methods.

Does Du Pont consult with automotive manufacturers?

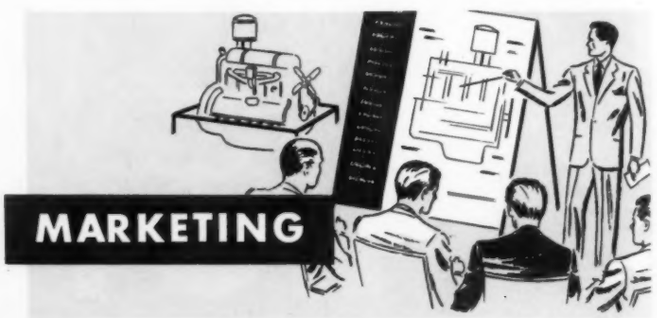
Yes. Du Pont has a staff of experienced engineers whose function it is to consult with research and technical groups of automotive manufacturing companies on problems related to the utilization of leaded fuels and other problems concerned with design and engine performance.

Does Du Pont also consult with tractor, truck, bus, aircraft engine and other manufacturers?

Du Pont works with all types of engine manufacturers on problems to improve engine-fuel relationships and on problems associated with the utilization of leaded fuels.

What other aids does Du Pont offer?

The results of Du Pont research are made available through the publication of papers and through joint meetings of Du Pont and refinery research personnel. By widespread dissemination of such information, Du Pont contributes toward the creation of better fuels and their more effective use.



What facilities does Du Pont offer to aid the refiner in his marketing program?

Representatives working out of the Du Pont District Offices are ready at all times to assist your marketing groups on specific promotional programs.

Can these men be called on to conduct meetings and help in educational work?

Yes. These representatives are available to work with

your own marketing group in conducting educational meetings among dealers and other personnel.

Does Du Pont supply information that will help a refiner evaluate the position of his fuels?

Du Pont provides a comprehensive quarterly gasoline survey which shows the octane rating and TEL content of individual gasolines in all geographical sections of the country.

Is Du Pont prepared to render assistance on automotive operational problems?

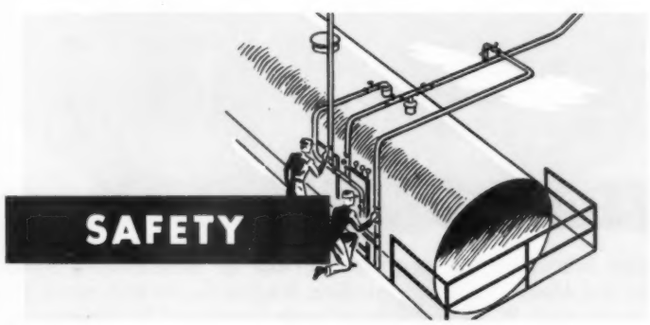
Du Pont's field engineers are always available to work with refiners and assist in applying preventive maintenance for truck, bus, tractor, and other automotive equipment operators.

How about aircraft engine operation?

These helpful field services are also available to work with airlines and airports on specific engine operating problems.

What about deliveries?

As the operator of its own fleet of tetraethyl lead tank cars, Du Pont has been able to maintain scheduled deliveries throughout the country.



Does Du Pont maintain a safety service for the benefit of those using Du Pont TEL Compounds?

Yes. It is made up of a group of specially trained men who can help you in many ways to insure the safe handling of tetraethyl lead compounds.

Can Du Pont help in making blending plant layouts?

Yes. Standard or special plans and specifications, as well as actual on-the-spot assistance, are provided in blending plant construction.

Does Du Pont help to train personnel for operation of the blending plant?

Yes. Du Pont will supply the type of training that results in safe employees and an efficient operation.

What does Du Pont provide in the way of inspection and maintenance supervision?

The safety services provide users of Du Pont TEL Compounds with a regular quarterly inspection service, assist in the application of preventive maintenance, and supervise any necessary maintenance and repair work. They will also advise on problems related to the cleaning and repair of tanks which have contained leaded fuels and will attend and advise on tank entries.

What about emergency field help?

On any problem involved in meeting emergency field conditions, Du Pont safety men will assist in working out a satisfactory solution.

What other services are offered by the Safety Group?

They will keep your personnel abreast of the latest approved methods of handling, circulating, and mixing TEL Compounds. They will work with your own laboratory personnel on problems related to the handling of TEL. In addition, they will help you in determining the adequacy and safety of your blending plant equipment and methods.

Does Du Pont supply a medical service in connection with the use of Du Pont TEL Compounds?

Yes. The Du Pont medical service comprises a group of physicians specially trained in industrial hygiene and particularly in the health problems that relate to the handling of tetraethyl lead compounds. They are always ready to cooperate with you in safeguarding the health of employees working with TEL Compounds.

Does the Medical Service aid in the selection of employees to work with TEL?

Yes. They will make preliminary health studies to determine employee suitability for work in these locations.

Does their responsibility end with the selection of the employee?

No. They will also make periodic examinations of such personnel to insure that proper hygienic standards are being maintained.

What other medical service is available?

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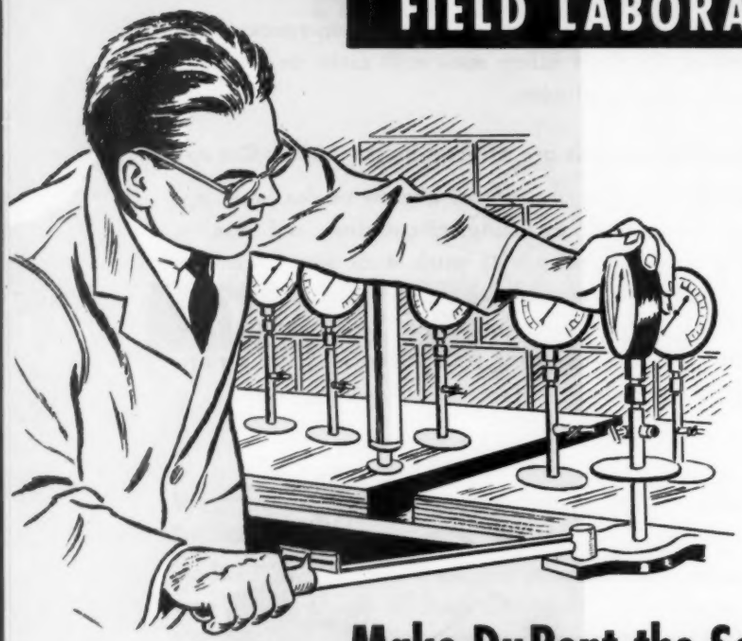

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This Month's Cover

When photographer Fritz Henle recently took his camera on tour of Cities Service properties, he returned with hundreds of pictures, many of them in full color. Asked which one of all these pictures he would select as his own favorite, Mr. Henle chose this scene in Texas. Color plates are reproduced through the courtesy of *Service*, a publication of Cities Service Company.

World Petroleum Index

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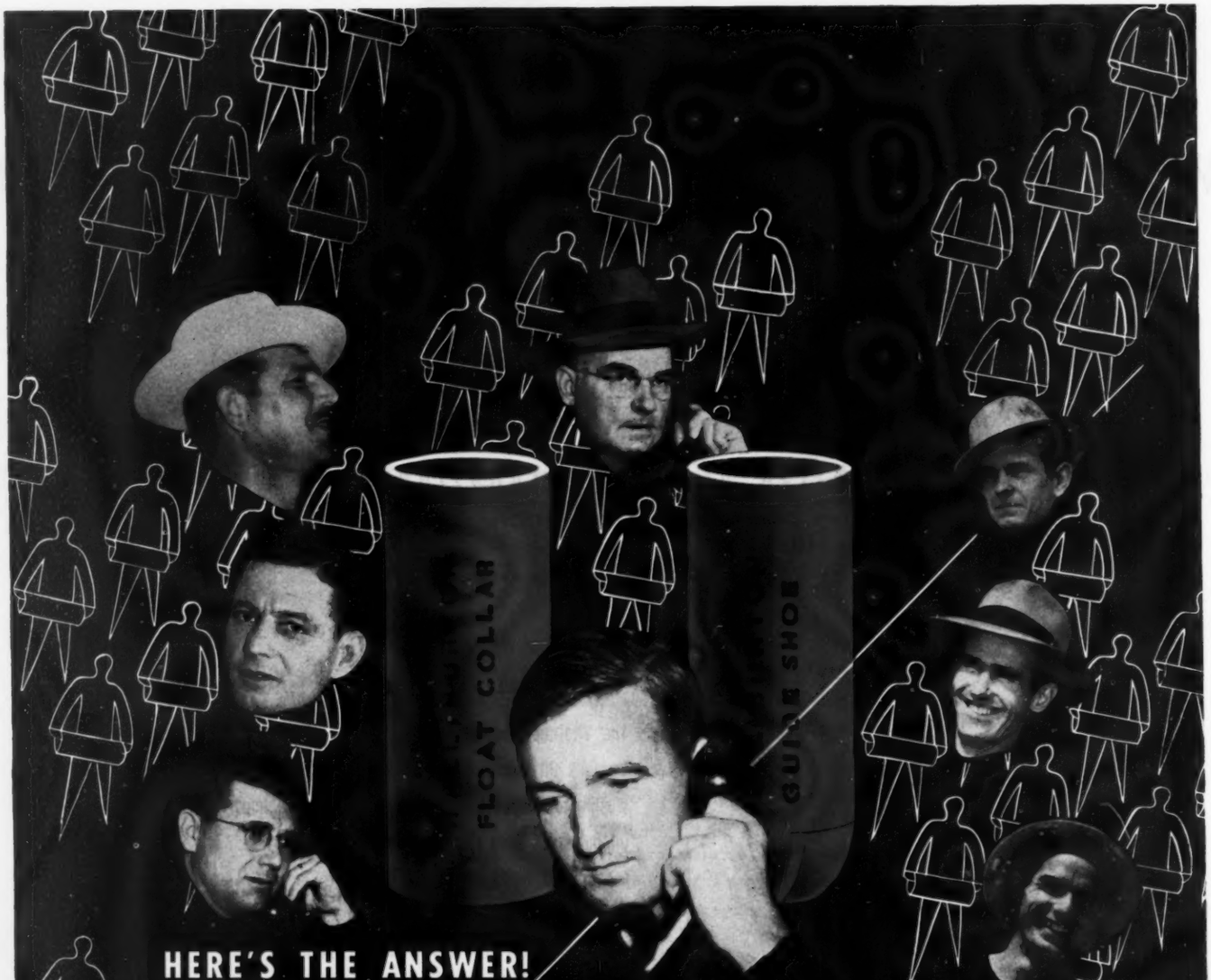

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EDITORIAL

THE VITAL QUESTION OF RESERVES

THE success of American oil men in finding and making available to the industrial development of the United States over a long period of years a supply of petroleum more than double that of all the rest of the world is due primarily to two factors. One of these is the intensely competitive organization of business under private control; the other is the prevalence by and large of conditions that encourage private capital to take the risks of that most hazardous business, the search for oil.

Because mining and oil production are industries utilizing non-replaceable assets and requiring continued effort to bring new supplies into use, the federal government long ago incorporated in its tax legislation applying to these industries a depletion allowance of 27½ percent. Without this incentive it would have been impossible to extend the search for oil to its present broad scope and to keep productive capacity ahead of fast-growing demand. While this provision has long been recognized as essential, its maintenance now is more important than ever because of the greatly increased cost of finding oil. It is estimated that the average expense involved in bringing in a new field by wildcat exploration is $250,000 or more, including the drilling cost of dry holes, but excluding the expense of leases and of geophysical exploration. Yet this is the moment selected by the President to recommend the reduction of this depletion allowance on the ground that it represents an unwarranted favoritism to the oil and mining industries.

Reserve crude capacity of the United States is the subject of a report prepared by a special subcommittee of the National Petroleum Council under the chairmanship of L. F. McCollum, president of Continental Oil Company, and submitted at the Council's meeting in January. This report traces the fluctuations that have taken place in known reserves from the close of World War I down to the present time. It shows a sustained growth that has kept well ahead of the rising demand for products with few exceptions. It also shows rather wide variations in the quantity of new oil discovered from year to year. Over the period of 30 years the total of known reserves has been multiplied more than three and a half times, but the percentage of withdrawals, representing consumption, has remained fairly constant, indicating that findings have been able to maintain a healthy margin over actual consumption throughout the period as a whole.

Under normal conditions a certain cyclical movement seems to prevail in the relationship between demand and new supply. When the use of petroleum products is expanding rapidly and remunerative prices prevail, exploration is stimulated and additions to known reserves increase rapidly. If the result is to raise supply beyond requirements temporarily, prices fall and the search for oil lags until the growth in use and the restoration of an attractive price bring renewed exploratory activities into play. During the depression years of the early 'thirties discoveries of new fields fell to the lowest levels recorded since statistics on exploration have been compiled. Again during World War II, there was a decline, but in this case it was the result of shortages of manpower and materials, together with a low fixed price.

The close relationship between supply and price was illustrated following the lifting of price controls in 1946 when an unexpectedly heavy demand for petroleum products prevailed. In the three years 1947-49 roundly 112,000 wells were drilled in the United States, an average of over 37,000 yearly or approximately 30 percent more than in the three active years preceding the war entanglement, and known reserves increased 20 percent. According to the report of the McCollum committee, the productive capacity of the oil industry has been enlarged by 1,600,000 barrels daily since the termination of the war. Available reserve capacity in 1949 was estimated as 700,000 barrels daily above domestic market requirements. Including the excess of imports above exports amounting to about 300,000 barrels daily, the surplus productive capacity was roundly a million barrels daily. This incidentally is the minimum figure set by military authorities as essential to national security in case of a serious emergency. So quickly has the petroleum industry banished the threat of shortage and placed the nation in a position of greater security so far as possible petroleum needs are concerned.

As the McCollum Committee summarizes the matter in its report: "Any change which would increase tax burdens on the production of petroleum above the present level would automatically reduce the incentive for development and make it that much harder to create reserve productive capacity. The provisions in the federal income tax laws allowing for percentage depletion and the charge of intangible development costs as expense have been worked out by Congress over a period of years as equitable and economical means of providing the necessary incentive for petroleum development that is indispensable to national welfare and security. Disturbance of such tax provisions would be a serious blow to the progress now being made in creating reserve productive capacity."

BRITAIN'S OIL SUBSTITUTION PLAN UNDERGOES FURTHER DISCUSSION

Washington

QUESTIONS raised by the action of the British government in seeking to substitute oil produced by British-controlled companies for that of companies under American ownership operating outside the United States were projected into the realm of public discussion by two developments during the past few weeks. First of these was publication of a letter from the British Colonial Secretary to an East African official at Nairobi indicating easy acquiescence by the State Department of the United States in the proposal to exclude American-owned oil from large trading areas as part of the plan to lessen the dollar gap in trade balance. The second was a 10-page document in which the British authorities explained their plan in detail. Significant points in the British statement may be summarized as follows:

(1) Oil is the largest item in dollar payments by sterling areas. The yearly cost is estimated at $625 million.
(2) British oil companies are now in position to produce an excess of oil beyond the immediate demands of their customers under the restrictions on consumption now in effect.
(3) The British government does not propose to disturb by substitution existing arrangements for the sale of American-owned crude to the sterling area or to British-controlled companies, but any extension will have to be judged on its merits.
(4) In order to define the extent of the proposed substitution of refined products, the British government is willing to give assurances that during the life of the Marshall Plan it will not exceed 4,000,000 tons. For 1950 the maximum amounts will be as follows:

Motor gasoline	750,000 tons
Kerosene	150,000 tons
Gas/Diesel Oil	500,000 tons
Fuel Oil	2,400,000 tons
Total	3,800,000 tons

(5) The suggestion that United States companies be allowed to sell to third countries against sterling payment is unacceptable because it would result in concentrating the effects of dollar shortage and inconvertibility of local currencies upon sterling.
(6) The statement maintains that the dollar content of oil produced by American-owned companies is generally higher than that of British companies, a claim which American operators challenge as to certain areas at least. It is indicated that consideration might be given to the proposal that American-owned companies be allowed to operate in sterling areas under the same conditions as British companies. It is specified that any such arrangement must be subject to certain provisions. These are that the arrangements must substantially reduce the dollar cost to the United Kingdom, that the operations must be carried on mainly in the sterling area, and that they must be conducted by companies resident there and subject to its taxation.
(7) It is stoutly maintained that "the United Kingdom has no intention of providing an expanding or protected market inside the sterling area for British companies. We are substituting British companies' oil because it saves us dollars." It is stated, however, that "while British company plans contemplate no more than normal expansion in third countries, this does not mean that their share of trade may not increase."

Acknowledging that the treatment to be applied to international oil trade is primarily the concern of British and Americans because of their predominant position in that field, the British communication is accompanied by an appendix which outlines an "incentive scheme" by which American companies can increase their trade with sterling and other soft-currency areas to the extent that they can reduce their dollar requirements as stated in the outline of the plan. "American companies would switch their expenditures from dollar to non-dollar sources, and themselves provide the dollar finance required to maintain and expand their trade."

Such items as equipment, stores and manpower from sterling areas, paid for in dollars, would be sure to "qualify" as credits toward larger markets in sterling areas. Expenditures of soft currency, when acquired through Britain with dollars, would qualify. This total could be "very substantial," it was stated.

No credits toward larger markets or convertibility of sterling earnings would be allowed for dollars spent in "investment" or capital cost, which has brought problems to the British in the form of profits, dividends and repatriation of capital. Nor would credit be allowed dollars spent for oil purchases, goods not required for the oil business and goods consumed in the sterling areas. Many expenditures, such as research funds, would have to be studied to determine whether they are outlays the United States companies "would not otherwise have incurred."

The incentive scheme could be "adapted" to meet problems of individual companies and is capable of "evolution," said the statement. Since the sterling content of different American oil companies differs, a base period or percentage increase in sterling for all companies would not provide as fair a ruling as individual negotiation with each company.

"We would expect the United States companies to consult with us about their programs for selling oil under the incentive scheme," the paper said. "In some cases it would suit us better if they sold such oil in the sterling areas, where restrictions on consumption could be raised for this purpose. In other cases it might suit us and them rather better if the oil were sold in third countries. All these points could, however, be taken care of in the proposed consultation.

"Other things being equal, we should always be ready to give parity of treatment to the imports of any United States companies' oil which cost us no more dollars than oil of British companies," said the paper. "We would prefer to follow a policy which, while defining the limits within the sterling area, will at the same time provide United States oil companies with the opportunity of maintaining and expanding their outlets according to the degree to which they reduce the dollar content of their oil."

In conclusion the British paper stated that if the incentive plan was favorably regarded, British officials would be prepared to undertake immediate discussions with the representatives of American companies as to its application. "The scheme outlined is not a cut and dried proposition," it added. "It would have to be adapted to meet the position of particular companies. We would hope that if something like this scheme is inaugurated, we would be able to ease some of the limitations which in the beginning we feel to be necessary.

We are ready to consider suggestions from the State Department of the United States and from United States oil companies, always provided that such suggestions do not lead to a dollar loss for the sterling area."

The statement of Britain's position was the subject of a conference called by the Department of State with representatives of ten major companies engaged in oil production outside the United States.

The official reaction to the British statement as expressed in a State Department release was that the oil company representatives "expressed strong reservations" to the British plan. "They did not consider," said the report, "that the proposal took into sufficient account the fact that all British company oil has a substantial dollar cost and that this must not be lost sight of in considering adjustments which United States companies may be required to make.

"They also felt the proposals were directed solely to the problem of dollar saving without allowance for other important considerations. However, recognizing the need of reducing the dollar drain on the sterling area, they again expressed a willingness to cooperate with the British government in devising arrangements whereby United States companies can make the maximum contributions to this objective through adjustments in their operation."

In view of the expressed readiness of Britain to undertake consideration of any suggestions that the Americans might have to offer within the limitations set forth, it was agreed that representatives of the oil companies would confer with the British delegates, reporting back to a subsequent meeting with the State Department.

Washington

WASHINGTON HOPES FOR AGREEMENT ON U. S. OIL IMPORTS

By Joseph Huttlinger

ONE QUESTION that threatened a few weeks ago to involve Congress in a sharp and prolonged controversy seems now in a fair way to amicable adjustment, possibly without any legislative action whatever. This is the question of oil imports. Opposition to such imports is not new. In the early thirties when the discovery of great new fields in the United States and elsewhere produced a flood of oil that forced prices down to a ruinously low level, it was strong enough to bring about the adoption of a tariff on crude and products which has since been reduced by reciprocal trade agreements to a point where it is no longer effective in keeping out shipments from outside countries.

During the war years imports were kept down by ocean transport conditions, but in the immediate postwar period when the unexpectedly sharp increase in domestic demand taxed the productive resources of the oil industry in the United States and inspired fears of a possible shortage, imports were welcomed and increased rapidly. In 1947 and 1948 there was a rise of 18 percent over the preceding years and in 1949 the growth amounted to 26 percent.

Meanwhile two other developments affecting the situation were taking place. As a result of intensification of the search for oil in the United States, productive capacity caught up with consumer demand and built up stocks to record levels. At the same time exports declined by 27 percent from 1947 to 1949. In 1948 imports exceeded exports for the first time in a quarter century, and in 1949 this excess of imports grew to over 300,000 barrels daily. In 1949 the productive capacity of United States fields was 700,000 barrels daily above requirements, and the output of wells in Texas and other producing areas was cut back to approximately this amount to avoid the waste attendant on overproduction.

This combination of circumstances was responsible for a strong resurgence of the demand for a curb on imports, either through the establishment of quotas or a tenfold increase in import duty or the exercise by the President of power conferred on him by the reciprocal trade agreements act. Associations of independent producers protested that they were suffering serious losses, and the National Petroleum Council, representing the industry as a whole, revised its earlier conclusion that imports did not endanger American producers and agreed that they had become injurious to the domestic industry.

While it is recognized that the complaint of the domestic oil producers is based on considerations that demand attention, other factors enter the situation. The fact that the country's oil wells could supply perhaps a million barrels daily more than they are allowed to produce at present without impairing their efficiency is viewed with satisfaction by military authorities who have steadily mantained that such reserve capacity is at all times a minimum requirement for national security.

Likewise the military believe that control of production in other parts of the world by American interests is of primary importance from the viewpoint of national security and that a certain amount of imports from these sources may be needed to enable companies operating abroad to maintain their position. In this they have the backing of the State Department which feels that the raising of tariff or other trade barriers would cause complications with other governments, would create unfriendly sentiment and might deprive the nation of oil at the time when it was most urgently needed.

Many oil men, who are thoroughly in sympathy with the idea that the domestic oil industry should be the first concern of American oil policy and should be allowed to supply domestic needs to the extent that it is able to do so in accordance with the principles of conservation, are opposed to the establishment of a quota system because they see in it the first step toward control of the oil industry by the federal government, which would be followed by a much further advance in its domination.

The principal importers of oil into the United States are the large organizations engaged in international operations or domestic corporations with insufficient crude supplies to cover their full market requirements. In 1947 and early 1948 when imports were in great demand, these companies increased their own shipments and in some cases entered into contracts to supply others. The declared purpose of the importers was to supplement and not to displace supplies indigenous to the United States, but some of the agreements for imports covered periods of considerable length and could not be terminated immediately. Furthermore developments in the international oil trade are making it practically impossible to find adequate markets for their products in other parts of the world. Nevertheless, the five companies which have been the largest importers have recently announced reductions in their scheduled programs of shipments for the current year aggregating some 70,000 barrels daily. This is not a deep enough cut to satisfy the producing interests who have been working for a drastic restriction, but it reflects the general desire of members of the industry to reach some adjustment without putting themselves too much under the domination of the federal bureaucracy. Congressional subcommittees will continue to study the subject, but if the oil industry can meet the situation by voluntary action, it will be a relief to many members of Congress and to some if not all administrative agencies.

Accompanying tables show the movement of imports and exports during the postwar period and also the sources of the oil that has been coming into the country from abroad.

U. S. Imports and Exports
Thousands of Barrels Daily

Year	Imports			Exports			Excess Exports or Imports
	Crude	Refined	Total	Crude	Refined	Total	
1945	203	108	311	90	414	504	193 (Exp.)
1946	236	134	370	112	302	414	44 (Exp.)
1947	267	170	437	126	325	451	14 (Exp.)
1948	353	160	513	109	260	369	144 (Imp.)
1949	434	211	647	91	237	328	319 (Imp.)

Imports of Crude and Products by Countries
Quarterly Averages — Thousands of Barrels Daily

	1948				1949			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Venezuela	257	263	235	275	251	271	294	341
Neth. W. Indies	170	137	139	142	164	182	192	244
Middle East	9	39	98	120	140	96	75	98
Colombia	16	24	27	28	29	29	31	38
Mexico	27	14	8	10	14	25	23	36
All Other	2	1	2	6	1	4	5	9
Total	481	478	509	581	599	607	620	766

Carter Oil Co. gravity meter party crossing swamp to set up new station in Cocodrie swamp, Concordia Parish, La.
Photo by Roberts for Standard Oil Co. (N. J.).

E. J. Handley, vice president, Century Geophysical Corp.

OIL INDUSTRY'S DEBT TO GEOPHYSICS

By E. J. Handley

Humble Oil & Refining Co. seismograph crew unloading equipment near Lake Arthur, La.
Photo by Russell Lee for Standard Oil Co. (N. J.).

IT IS still true that oil is where you find it. No sure-fire means of locating liquid treasure lying thousands of feet below the surface has yet been devised. The final test remains that of the drill. And if one is a philosopher, perhaps he can develop a convincing argument to prove that it is a good thing for mankind that the way to oil is still a hard way.

It is true also that much oil has been found in the past by following surface indications or with no better guidance than provided by lucky dreams or hunches. But with the evolution of petroleum production from an exciting adventure to one of the world's great industries, something better than the old hit or miss procedure was required, and this has been provided by the accumulation of geological knowledge and the development of geophysical methods and tools. These are the means by which the world's daily output has been raised above nine million barrels, and by the progressive application of which it will be possible to discover the billions of barrels that will be needed to replenish reserves and to satisfy ever-growing demand.

Everyone knows that geology is the science that concerns itself with the study of the earth in general and with the rocks of the earth's crust in particular. Geologists are interested in all aspects of these rocks and in all factors that are directly or indirectly associated with them. They are thus interested in all of the various forms of life as it existed on the earth throughout the past geological ages, as well as in the physical properties of the rocks themselves. It is becoming commonly known that geophysics is the science that deals entirely with the physical properties of the earth. These physical properties include those specifically associated with the rocks, such as elasticity, porosity, density, permeability, resistivity, magnetic susceptibility, and so forth. In using the gravimetric, magnetic and electrical geophysical methods, one generally measures differences in various physical properties of the earth at successive points of observation, and unusual variations in these measurements constitute anomalies which can be shown to have geological significance and may be associated with structures favorable to the accumulation of oil. In the seismograph method the geophysicist actually measures only time and distance. Distances are measured by conventional surveying methods on the earth's surface. The times which are measured are the time required for sound waves to travel through the earth along various paths. Direct geological data is seldom obtained, but a geological interpretation is inferred from the physical measurements of time and distance.

The science of geophysics first proved itself practical and exhibited its value in assisting the oil industry in the search for oil by measuring variations in physical properties whose anomalies indicated the existence of salt domes. The first spectacular success was made by measuring variations in density. Salt is less dense than shale and, therefore, a pendulum or a torsion balance could detect a density minimum leading to the discovery of salt domes. The elasticity and density of rocks determine the velocity of a sound wave traveling through them, and since sound travels much faster through salt than through shale, the early date refraction seismograph measurements yielded data whose anomalies were directly associated with potentially productive geological structures, namely the salt domes. In these instances the anomalies which resulted from the geophysical measurements were so directly related to the geological structure and the interpretation was so direct and simple that little study needed to be made of the geological significance of the geophysical data. Electrical and magnetic methods were also applied to the salt dome problem in the early days, but the data was not as diagnostic of potentially productive structures as that from measurements obtained from the gravity or refraction seismograph methods.

Following the numerous discoveries of salt domes, the geophysical profession began to adapt itself to the problem of finding anticlines or structural traps primarily depending upon structural closure, which structures were detected by measuring the dip of the geological beds at the depth of the structure. This led to the development of the reflection seismograph method, which is essentially a sounding method and fundamentally takes the simple form of determining the travel time of a sound wave down to and back from a reflection interface. The depths to a reflection interface from various points of observation on the earth's surface are generally computed on the assumption that the velocity of the wave remains constant. The development of this method enabled the oil industry to continue is anticlinal search into the great sedimentary basins and into those areas where outcrop rocks were not available to the geologists for direct dip measurements.

Geophysics has become perhaps as much an art as a science. Geophysical data have begun to be evaluated more and more in terms of their geological significance. We are now developing a generation of geophysicists who are trained in college in geology as well as in physics. In the early days it was true the geophysical data could be used almost in its purely mathematical form to find oil, and for a while the profession developed a sort of voodoo cult with its high priests who talked in a language all their own, but by the very nature of the geological problems which they were attempting to solve, they were led to admit that their formulas were fallible and often unintelligible and certainly not useful unless and until they were evaluated in terms of known geological precepts. As the search for salt domes declined and the reflection seismograph method began to be developed, it appeared that the data obtained by this geophysical method were closely correlated with geological structures. It became evident that the geophysicist needed to develop a geological background for his thinking in order properly to interpret his physical measurements. This led to a growing partnership between geology and geophysics.

Since its inception, the reflection seismograph has continued searching more or less constantly for anticlines or associated dip controlled structures, and the search has spread throughout the world. In carrying on such a widespread search, the profession had to adapt equipment to meet the needs of the terrain to be surveyed. Special equipment was designed for work in frozen arctics, in mountainous terrain, swamps, marshes, jungles, sand dunes and deserts. Every problem that arose merely constituted a challenge to the men of vision and vigor who carried on the geophysical survey under conditions which at times were appalling insofar as the physical hardships endured by the men actually doing the work were concerned. These difficulties were sur-

Seismograph crews are busy in the frozen north as well as in tropical swamps. Century Geophysical photo.

mounted and the search was continued with the tenacity of a military campaign. Marsh buggies were built, mud wagons with great drums or roller belts for wheels, air boats, snowmobiles and portable equipment were designed. The gravity men developed the gravity meter and later developed the use of grotesque diving bells with remote control instruments for water work. Seismograph men developed equipment to shoot the continental shelf areas and triumphed over almost unsurmountable difficulties. Special electronic surveying devices were invented which enabled the water work to be carried on accurately far beyond the sight of land, and traverses a hundred miles long could be run with a negligible error of closure.

Although the reflection seismograph method has been applied largely to continuing the search for oil in accordance with the anticlinal theory developed earlier by geologists, it has recently been applied to the problem of discovering buried reefs where dip measurements alone may not be indicative of possible oil or gas deposits. Although it is true that some random wildcat drilling has resulted in discovery despite the great odds against it, it is well to recognize that practically all of the oil that has been discovered in recent years has been found as a result of obtaining geophysical data which have been properly interpreted geologically. After the present search for buried reefs has passed its most intensive stage, it appears that the reflection seismograph will be more intensively applied to the geological problem of locating stratigraphic traps. Greater success may then be obtained in the discovery of oil and gas production from various types of unconformity and overlap traps and from porosity discontinuities located at or near unconformities. The retrospective study of the development of the geophysical profession tends to confirm our belief in a theory that perhaps we all feel intuitively, which is that the ultimate solution of a problem is practically assured once the thinking of a great many minds is intensively focused upon it. The mapping of stratigraphic type traps will be difficult and will require the joint efforts of geophysicists and geologists. We can expect considerable improvement in the accuracy with which the geophysicist makes his physical measurements as well as an improvement in the proper interpretation and evaluation of these data. Although such measurements and their interpretation have already been advanced far beyond the expectations of the pioneers in this profession, geophysical data are not infallible, but to admit their fallibility is not the same as saying they can never be right and, therefore, are to be disregarded. A geophysical anomaly, and more particularly a reflection seismograph anomaly, may not produce oil but it is likely to do so.

One might make the generalized statement that the first 25 years of this century constituted the "Golden Age of geologists." During this period the anticlinal theory of oil accumulation was developed, and anticlines were discovered by actually mapping the dip of the rocks as they were observed at the surface. During this period practically all of the potential oil-producing areas were walked over and mapped by field geologists. As most of the well-defined surface structures were found and drilled, geophysics provided a means of discovering salt domes, as just related, and this ushered in the second 25-year period of this century, which could well be termed the "Golden Age of geophysics." In a similar vein, one might say that the next 25 years will be the "Golden Age of oil exploration" in which geologists and geophysicists will work together as an exploration team.

It is evident that the economic burden of carrying on the search for oil is becoming heavier and that these exploration costs are largely due

Cable laying operations may call for a considerable change in costume. Photograph at left courtesy Century Geophysical Corp. Photograph below courtesy Standard Oil Co. (N. J.).

to the increased costs of geophysical exploration; but when we see this phenomenon, we should recognize that in all but very exceptional cases the costs are created by problems presented by the terrain in which the survey is being conducted, and the high costs are indicative of the successful solution of these problems. The problems are often associated with merely getting over the terrain, and it is reassuring to recognize that the search for oil is thus continuing in areas heretofore considered inaccessible. In the final analysis the high costs of exploration will have to be borne by the ultimate consumer, and that individual can pay more for oil and gas and the fuel products derived from them than he is paying at the present time and still receive those products cheaper than he can get by substitutes from any other source. It seems that honest counsel and prudence should lead us to expect continuing higher cost of geophysical exploration which can only be counterbalanced by an increase in the sale price of the final products resulting from their discoveries.

The geophysical profession has made a tremendous contribution to the oil industry, and it will continue to do so for many years to come. No one knows how close we are to the point of diminishing returns in the search for oil. Synthetics, shale oil and oil sand products will ultimately have their impact on our economy and upon civilization as a whole, but it is certainly premature to take an alarmed or pessimistic view of the oil business as we know it in the foreseeable future. The recent tremendous reserves which have been discovered in western Canada should serve as sufficient stimulus for individuals who are in policy-making positions within the oil industry to regird themselves and continue their search more intensively than ever before. Oil will continue to be found by exploration teams utilizing geophysical methods, and over-cautious individuals who base their policy on the psychology of fear will not precipitate a recession in the oil industry as a whole, but rather it appears that they will merely drop back in the procession in which the more successful operators will continue to go forward. The search for oil will be extended to less accessible regions throughout the world, and we reiterate that there appears to be considerable margin between what this oil will cost us to find and the cost of any satisfactory substitute which could be provided on the gigantic scale that would be necessary.

Because of the high cost the search for oil has become almost a crusade, and those who will be most successful in this effort will be men of vision who will support their exploration teams and lead them forward with faith and courage. In this struggle to continue to discover additional reserves, the real heroes are the men on the firing line, so to speak, which is on the geophysical field parties. Whether it is a "cold war" in Canada or a "hot war" in the tropics, the geophysical crew will carry on the search for oil with an inspirational fervor, and they are being led by party chiefs who have the brains and the courage to continue the search despite the difficulties that will be encountered.

Above: Carrying centrifugal pump into a Louisiana swamp for shot hole drilling near Lake Arthur, La. An outboard motor is used to pump drilling mud from a slush pit dynamited in the swamp to drill shot holes such as in the operation shown below. Photographs by Lee for Standard Oil Co. (N. J.).

LOCATING OIL FIELDS WITH RADIO WAVES

By Wm. M. Barret*

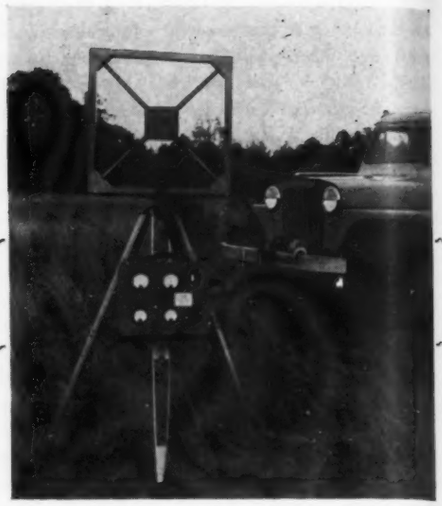

Figure 1—Receiver and loop antenna mounted on a tripod, with truck for transportation at right.

THIS article deals with a new geophysical method which has for its purpose the location of oil fields by means of radio waves.

One of the distinguishing characteristics of the method is its ability to locate oil ***directly, rather than indirectly*** through the location of favorable structures, such as is done by the seismic, gravimetric and magnetic methods. This it does by detecting the electrical contrast that occurs at the outer edges of an oil field, where the oil generally lies in contact with salt water and in some instances in contact with sedimentary strata. Practical experience shows that this contrast usually is sufficiently pronounced to cause easily recognizable effects, or anomalies, at the earth's surface when radio waves are properly directed against the outer boundary of an oil (or distillate) accumulation.

But to accomplish this in practice it is necessary that radio waves be made to travel deep into the earth, and until recently it was a highly debatable question as to whether or not such waves could be made to penetrate the earth to any substantial depth. Most authorities claimed that it could not be done, and there was a wealth of experimental evidence to support their viewpoint. Not a few, however, admitted that if radio waves could be transmitted to depth in the earth, then the electrical properties of a number of important minerals, including petroleum, were sufficiently anomalous to make possible their direct detection.

In December 1948 an event occurred that not only altered the viewpoint of many authorities on this question but also opened new frontiers in exploring the earth for mineral deposits. It took place in a deep salt mine at Grand Saline, Texas, when William M. Barret, Inc. demonstrated to a group of scientists a revolutionary method that makes possible the effective transmission of radio waves through the earth. The event was reported in the March 1949 issue of WORLD PETROLEUM under the title, "Earth Penetration of Radio Waves Proved by Salt Mine Tests."

Soon thereafter the writer described the basic principle of operation of the method and touched briefly on its implications in the search for underground mineral deposits in an article entitled, "Exploring the Earth with Radio Waves," which appeared in WORLD PETROLEUM for April 1949. It is the purpose of the present article to show how the new method is employed in locating oil fields. When thus applied it is called the Radoil method, from its use of radio waves to detect the presence of oil. The discussion will be brief and practical.

The Radoil method employs a generator of radio waves, termed an exciter, the output of which is fed into the earth through a special form of directive radiating system; a portable receiver for picking up the waves transmitted by the exciter, and two-way radio communication between the exciter and receiver units. In Figure 1 is shown the type of receiver ordinarily used and in Figure 2 appears a truck mounted exciter.

The equipment is operated by a field crew which normally consists of a party chief, a field chief, an exciter operator, a receiver operator and an assistant receiver operator. When satisfactory land maps are not available, the crew personnel also includes a surveyor and a rodman.

In operation, the crew locates the exciter at one extremity of a substantially straight traverse that crosses over the "prospect" to be investigated, its distance (or spread) from the prospect being determined by the required working depth, increasing exciter spread corresponding to increasing depth. Then the receiver is operated at successive stations along the traverse.

When the exciter is energized, radio waves are transmitted along the earth's surface in the direction of the receiver. A part of the wave energy travels along the ground to the receiver and a part is refracted downward into the earth as the waves move toward the receiver. In the absence of an oil field, the readings at the receiver are determined largely by the strength of the waves that travel along the ground, and in general the readings decline progressively as the receiver is moved away from the exciter. A graph illustrating this condition is referred to as a neutral profile. However, when an oil field is present, and the exciter is properly positioned with respect to the field, then some of the waves refracted downward into the earth strike the outer boundaries of the field, where the electrical contrast causes their partial return to the earth's surface in the form of reflected and diffracted waves, which rejoin the waves traveling along the ground and finally arrive at the receiver as it occupies successive stations along the traverse overlying the field. Waves reaching the receiver from the neighborhood of the "near" oil boundary (as measured from the exciter) produce what is called a diagnostic anomaly, and this anomaly is represented by a characteristic variation in the receiver readings. And similarly, the "far" oil boundary gives rise to anomalous receiver readings which define what is termed a boundary anomaly.

The absence of oil is therefore indicated by neutral profiles and the presence of oil is indicated by diagnostic anomalies and boundary anomalies. The character of these three types of indications will be understood from the practical examples that follow.

First of these is the neutral profile of Figure 3. This profile, like those to follow, is nothing more than an average curve that is drawn through the various receiver readings (solid circles), which are plotted against the respective positions on the ground at which the readings were observed. It is one of a group of similar profiles that was used in condemning the surveyed portions of the crest and south flank of the well-known Pine Island anticline of Caddo Parish, La. for deep oil saturation below the established shallow production. An 11,418-foot dry hole and an 8,510-foot dry hole later confirmed the Radoil results. Prior to drilling, Pine Island was generally considered an outstanding prospect and well over a million dollars were invested in exploring, leasing and drilling the prospect for deep oil.

Illustrative of the character of the diagnostic anomaly, which is developed over the near side of an oil field, is the profile of Figure 4. The principal characteristics of the diagnostic anomaly are a maximum in receiver readings followed by a similar minimum and an angular "break" in the profile. The dashed reference line is added to display with greater clarity the conjugate maximum and minimum. Only when the exciter is the correct distance from one side of an oil boundary can the diagnostic anomaly be developed. If it is too far away, or too near, the anomaly fades out. The determining factor is the depth of the oil saturation, and for each depth there is a corresponding optimum spread for the exciter. Once the depth of the oil is known, the optimum spread is also known, and conversely, when diagnostic anomalies are obtained in a wildcat area,

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Figure 2—Truck-mounted exciter unit, showing operating panel and power plant.

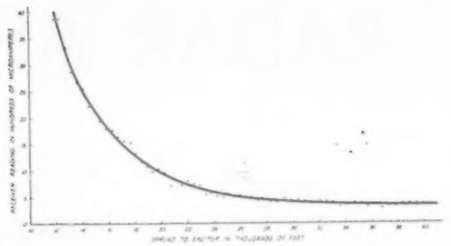


Figure 3—One of a group of neutral profiles used in condemning the Pine Island anticline of Caddo Parish, La., for deep oil.

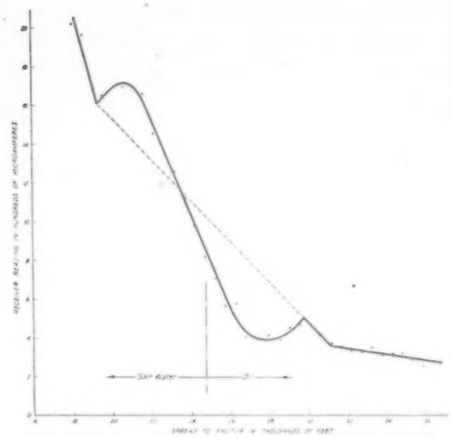


Figure 4—Diagnostic anomaly caused by a Smackover oil boundary lying at a depth of about 7,600 feet in the Magnolia field of Columbia County, Ark.

then the approximate depth of the related oil accumulation is easily found.

The diagnostic anomaly shown in Figure 4 is but one of a group of similar anomalies that made possible the mapping of a 2.5-mile westward extension of the 7,600-foot Smackover oil saturation in the Magnolia field of Columbia County, Ark., and the discovery of shallower oil at a predicted depth of approximately 6,000 feet. The first well drilled in the extension area was located 1.5 miles west of production, and it encountered 173 feet of oil saturation above the Smackover water table. Many years after the Radoil survey, drilling confirmed the presence of the shallower oil section when production was obtained from the Cotton Valley formation at depths ranging from about 5,450 feet to 6,400 feet. The Smackover extension mapped by the Radoil survey could not be anticipated from the subsurface information available at the time, nor was it suspected from the results of several other geophysical surveys. Moreover, the shallower Cotton Valley oil saturation was not disclosed by the electrical logs then available.

The profile of Figure 5 is representative of the boundary anomaly that is obtained over the far side of an oil field. It consists of a break in the profile that lies over the oil boundary, and another break that falls beyond the boundary. The separation of the two breaks varies with the depth of the oil deposit, and accordingly provides another yardstick for determining the depths of wildcat fields. The boundary anomaly appearing in Figure 5 is one of a number of similar anomalies that was obtained in a survey of the Dorcheat field of Columbia County, Ark. Intended primarily to define certain limits of the 8,800-foot Smackover oil saturation, the Radoil survey also disclosed an oil-saturated section lying well above the established production. More than two years later the predicted oil saturation was verified when the discovery well was completed in the Cotton Valley formation. Some forty Cotton Valley producers completed to date show that the oil (or distillate) saturation occurs in lenticular sands whose depths range from about 6,800 feet to 8,550 feet.

It is believed that the preceding examples of a neutral profile, a diagnostic anomaly and a boundary anomaly are sufficient to bring out clearly the sharp distinction that inherently exists between the Radoil indications of the absence of oil and of the presence of oil. To make possible a more direct comparison of these indications, the examples illustrated were intentionally selected from the same general area.

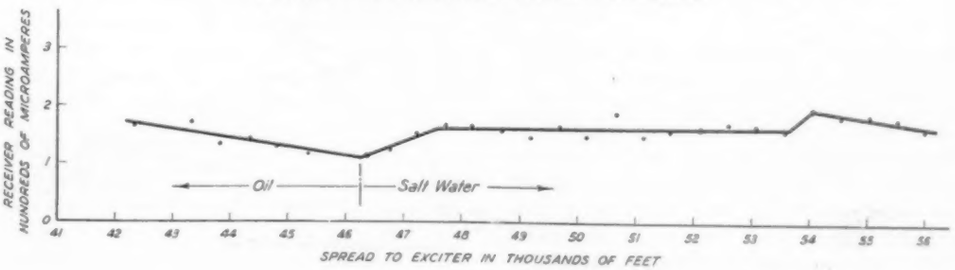
At the present time the Radoil method is more adapted to detail surveys than to reconnaissance surveys. It is accordingly well suited for determining the oil-producing possibilities of prospects which have been localized by conventional geophysical methods and by geological methods. Another useful application of the method is in outlining the limits of new fields, so as to avoid unprofitable drilling. Still another application is in evaluating acreage around the margins of partially developed fields. And finally, the method is useful in detecting undiscovered oil zones in known fields.

The time required for a Radoil crew to condemn a wildcat prospect generally runs from two to four weeks, and from three to six weeks ordinarily are needed to detect the presence of a wildcat oil accumulation; to determine its approximate depth, and to outline the field in reasonable detail. Usually the presence of an extension to a partially developed field, or the presence of an undiscovered oil zone in a known field, can be established in less time than it takes to survey a wildcat prospect.

More than 300 surveys have been made throughout the United States with the Radoil method. These surveys involved the condemnation of many prospects and areas that were found to be devoid of commercial oil saturation, as well as the detection and mapping of oil accumulations in various types of structural, stratigraphic and lithologic traps. The method has already been successful in delineating oil deposits at various depths between 300 and 9,000 feet, and in isolating and mapping individual oil zones which occurred in a section comprising multiple saturated zones. Almost 100 surveys have investigated wildcat areas that subsequently were tested by drilling to the depths explored by the surveys. The outcome of this drilling makes it clear that the Radoil method is more reliable in determining the presence of oil than the conventional geophysical methods are in determining the presence of structural conditions favorable for the accumulation of oil.

The Radoil method is covered by patents, and is being made available to the industry through license arrangements and contract surveys.

Figure 5—Boundary anomaly caused by a Cotton Valley oil boundary lying at a depth of about 7,100 feet in the Dorcheat field of Columbia County, Ark.



RADAR AS A SURVEY INSTRUMENT

By O. E. Haley

ACCURACY, speed and safety—three of the most important factors in determining costs and evaluating the results of marine geophysical prospecting—are to be found in this wartime weapon, radar. Several other "radio" methods of surveying are being used successfully, but it is not within the scope of this article to compare their relative merits. Rather, it is desired to clear away some of the misconceptions of what radar can and cannot do.

Radar lends itself particularly well to the specialized needs of offshore geophysical operations, but not, however, until its possibilities and limitations are fully understood. Also very few radars are usable for survey work as they come off the assembly line. They are designed primarily for military or navigational purposes and must be modified extensively to be used as surveying instruments. This may account for the failure of some of the radars used in this work immediately after the war to live up to expectations. The technical problems involved in these modifications were covered in a paper given before a group of the geophysical technical section of the AIEE in April 1949 and will be omitted here.

The value of radar in land exploration is dubious except, possibly, as an auxiliary method in large areas with no outstanding landmarks or difficult terrain, and where great distances must be covered. A major oil company has used radar in refraction work in west Texas. While no figures are available on the comparative per-acre cost over conventional methods, the daily coverage was increased with the use of radar in this area.

The determination of azimuth or direction with most radars is not sufficiently accurate for survey purposes. In very elaborate installations, such as those used to aim naval rifles, azimuth accuracy can be held to a fraction of a degree, but these types would not be economically feasible for geophysical work. Too, in the presence of rain squalls, cold fronts and other exceptional weather conditions, there may be considerable lateral refraction of the radar waves which would nullify this accuracy. Fortunately such refraction has a negligible effect on measurements of distance.

Measurements of distance can be made with practically any degree of precision required by measuring the elapsed time between sending a signal from the radar antenna and reception of its echo from a reflecting object. Time can be measured more accurately than any other quantity known to science, but there is a limit to the degree of accuracy usable. An optimum error of plus or minus twenty feet under ideal conditions has been established in the case under discussion. Indeed, it is an exceptional man who can maneuver a hundred-foot boat or drop a marker buoy to within twenty feet in deep water, even in moderate weather! In everyday work this error may be as much as fifty feet due to the motion of the boat in rough weather or poor definition of the target. This optimum error allows the use of some very convenient methods of reading distances and greatly speeds up these readings (average time per reading: 10 seconds). Fortunately, this error is constant for any distance except for a very small increase of one or two inches per mile, which is caused by the frequency standard against which the time is checked.

In using radar as a survey instrument, we are limited primarily to this one function. Angles and directions taken directly from the radar are very useful in some operations but should not be used in direct calculations of position.

O. E. Haley, electronics supervisor, McCollum Exploration Co.

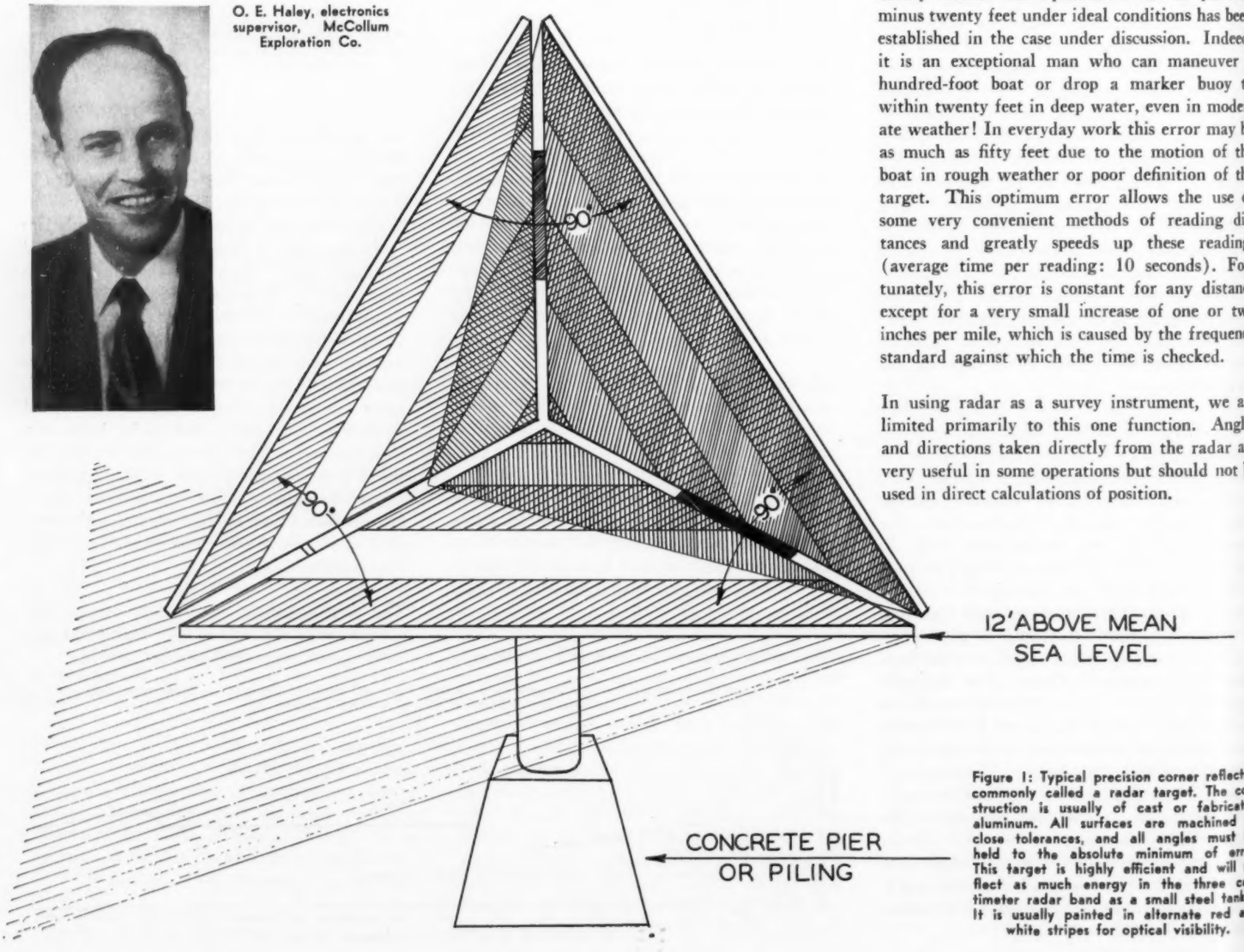


Figure 1: Typical precision corner reflector, commonly called a radar target. The construction is usually of cast or fabricated aluminum. All surfaces are machined to close tolerances, and all angles must be held to the absolute minimum of error. This target is highly efficient and will reflect as much energy in the three centimeter radar band as a small steel tanker. It is usually painted in alternate red and white stripes for optical visibility.

Before a radar can be put into service, it must be calibrated. In each installation there is a fixed delay caused by the time required for signals to pass through the cables and wiring. This calibration is accomplished by tying up the boat at some sheltered point such as a river, harbor or canal in such a manner that there is no movement. A large number of readings are then taken from accurately measured points upon which reflectors are placed. The mean error is subtracted from the readings and used to compensate the scale from which readings are later taken. Once this is done, no further calibration is necessary.

In practice, special targets or reflectors are used. These reflectors are made entirely of metal, usually aluminum, and look very much as though someone had cut a corner off a large metal box diagonally. Each reflector has three sides; each side at right angles to the other two. The principle is the same as that of the reflectors on the highway signs that reflect your headlights as you approach from any point in a very wide angle. The targets are from two to four feet on each edge (depending upon the wave length of the radar used) and are very efficient. A properly designed target will reflect as much energy back to the radar as a cruiser or small tanker.

Surveying is done by simple triangulation (Figure 2) from two or more of these targets placed at strategic points along the coast. The selection of a proper site for target location is perhaps the most troublesome aspect of the entire system. The most desirable but least practical location would be to set the targets on pilings about one or two thousand feet from the shore line, or at least at a point beyond the start of breakers in any but the roughest weather. The desirability of this location is pointed out by the fact that the beam width of the antenna radiation pattern is four degrees. At the longer ranges this beam covers a fairly wide area, and if there is another reflecting object within this area at about the same distance, confusion could cause a serious error. Target identification is extremely important.

One of the procedures used in surveying is, roughly, as follows: In starting work on a new location, the radar boat (which is also the recording boat) proceeds on a compass course toward the starting point of the block to be explored. As the boat approaches the location, the radar operator jockeys the pilot into position. At his signal a special floating target is dropped overboard. After the floating target has settled on its anchor, the boat circles around and pulls up alongside. The operator takes precision readings to the base line targets ashore. If corrections are necessary, the floating target is reanchored and its position plotted on a large aluminum chart. This floating target then becomes the focal point for all the local surveying.

Speed and direction of the tide can be determined by allowing the boat to drift for a few minutes away from the floating target. This drift is plotted and a compass course determined in order to run the boat in the desired direction. The

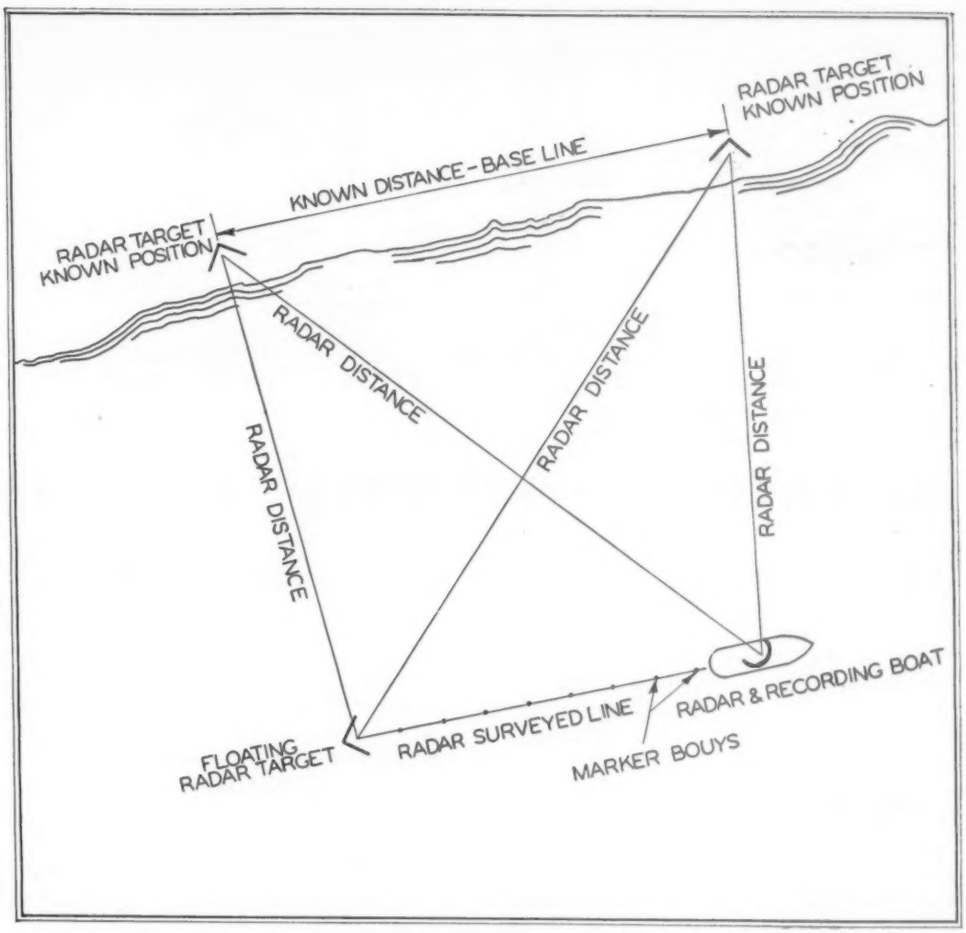


Figure 2: Illustrating the use of simple triangulation when radar is used as a survey instrument. This is explained further in the text.

radar boat circles again and approaches the floating target from the proper direction to run the desired course. As the target is passed, operations begin.

At the proper intervals the radar operator, who is constantly ranging on the floating target, signals the buoy-setters; they, in turn, toss small expendable marker buoys, consisting of a sash-weight anchor, cord and a small balloon, over the side. This does not sound like a very precise method at first, but with coordination and practice, a rhythm is soon developed, and the intervals between the buoys are amazingly consistent. This procedure continues until the desired length of line has been run. The radar boat then pulls up alongside the last marker, and its position is triangulated from the shore targets. The result is a satisfactorily straight line of evenly spaced markers. Of course, at all times the length of the buoy anchor lines, direction of the tide and distance from the buoy being triangulated to the radar antenna must be considered. Estimations of even short distances in the order of forty to fifty feet over water are subject to great error and cannot be accepted if the best accuracy of the radar is to be utilized.

After the line is established, shooting and recording proceed in the conventional manner. Lines are usually laid out only as needed. As mentioned before, the directional properties of the radar are insufficiently accurate to run a straight line using the radar as the sole guide. The boat could run about two degrees off course in either direction before the operator could detect it, resulting in a zigzag line. The compass-course system gives the straightest line, and even though the actual course deviates a few degrees from the one desired, this error is detected when the far end of the line is triangulated and the true direction is plotted on the chart.

This illustration is of the simplest form of surveying, but other work is based on the same methods. The versatility of the radar is limited only by the ability and imagination of the personnel, both operational and technical.

Other important considerations are: stabilization of the antenna (for rolling and pitching of the boat), gyroscopic compasses, range-determining devices and other technical features which need not be included in this article.

A popular fallacy and a major deterrent to the use of radar by more crews than are now utilizing it is that radar is limited to "line of sight." This is not necessarily true. The phenomena of super-refraction or the detection of objects far beyond the horizon by surface radar was first observed during the war; in one case of record this distance was 1,500 miles! And the detection was reasonably consistent. A large amount of investi-

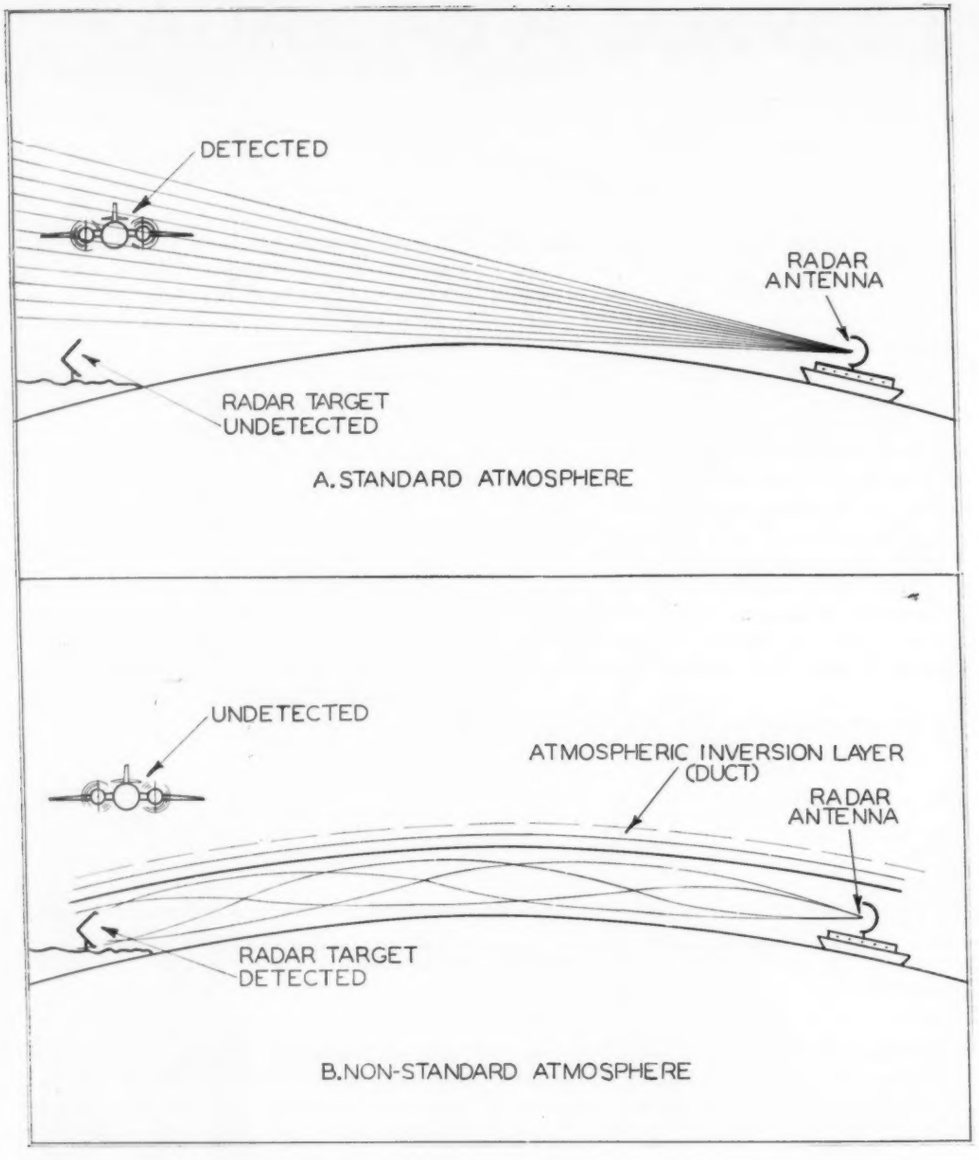


Figure 3: Illustrating the effects of atmospheric conditions on the propagation of the three centimeter radar band signals on over-water paths. A. The standard atmosphere where very little refraction of the radar signals occurs. Objects beyond the horizon are not detected in this case. B. The non-standard atmosphere wherein the microwave radar frequencies are trapped, and objects many times the distance beyond the horizon may be detected. This latter condition is the rule rather than the exception over certain large bodies of water, particularly the Gulf of Mexico adjacent to the coasts of Texas and Louisiana.

gation and work has been done by government agencies and individuals to understand and use the super-refractive characteristics of the atmosphere and their relationship to microwave propagation.

In brief, the principle of super-refraction is this: the atmosphere immediately above a large body of water is sometimes stratified into layers of marked change in refractive index. Any radio wave or light wave is bent when it encounters a change of refractive index in the line of propagation. This is illustrated by the optical lens. The higher frequencies are bent more than the lower frequencies. This, in turn, is illustrated by the spectrograph where the blue light is bent more than the red light, even though they pass through the same prism.

The writer's personal experience with super-refraction is limited to the Gulf of Mexico in the area adjacent to the coasts of Texas and Louisiana and extending outward about one hundred miles. The most common atmospheric condition noticed in this area in moderate weather is a layer about twenty to fifty feet thick, immediately above the water. This layer is referred to by radar men as a "duct" and by meteorologists as an "inversion layer." Its existence has been known for many years by the meteorologists, but its value in geophysical radar has been recognized only recently.

If the radar antenna is in this duct, and reasonably close to the center, the major portion of the energy will be trapped within the duct, and detection of surface objects in excess of two hundred miles distant has been a frequent occurrence. (This was the maximum range of the particular radar used without circuit changes.) Detection of surface objects at ranges of fifty miles is the rule rather than the exception in the summer months and is a frequent occurrence in the winter when the weather is sufficiently mild to allow shooting and recording. It might be well to point out that this is true in this area only of the three centimeter, or "X" band radar. Very little "duct" effect is noticed with the longer wave lengths.

This trapping action of the duct is similar to that of a bent lucite rod. If a source of light is placed at one end of the rod, it can be seen at the other end, and very little of the light will leak out the sides.

This duct effect is not observed in the presence of fog, rain or winds in excess of twenty-five miles per hour. Fortunately such conditions do not ordinarily affect the use of the radar for local work, and key points of local survey can be tied in when more favorable conditions prevail.

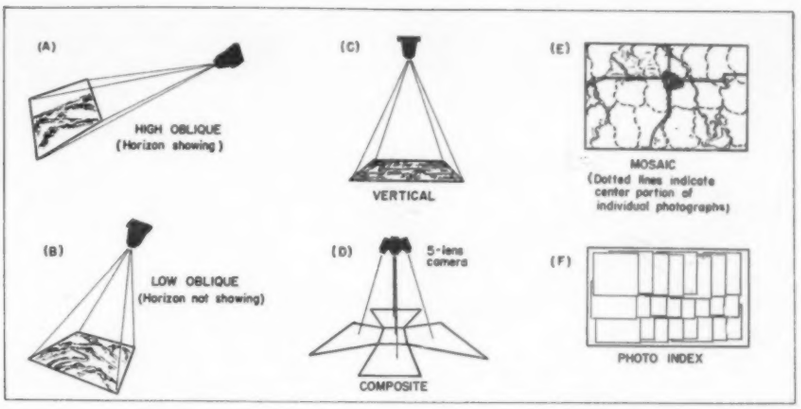
One of the principal advantages of radar is that it operates efficiently in weather conditions that would not permit conventional work. The limiting weather factor is shooting and recording, not surveying.

The duct effect is covered thoroughly in two volumes published by the National Defense Research Committee, "Wave Propagation Experiments" and "Summary and Technical Survey." It is this phenomena which has done much to make radar a valuable tool to the geophysical industry. Undoubtedly others will take advantage of it in the future.

While initial cost varies greatly, the expense of operating a properly modified installation is small and requires only one man. No shore installations other than the targets are necessary. In some cases the use of a radar beacon is advantageous. This requires another operator ashore, but the equipment is lightweight and portable. One of the smallest used by the McCollum Exploration Company weighs only two and two-tenths pounds less batteries! A slightly better one weighs seventy-five pounds complete with batteries and tripod. Any intelligent person can learn to set up either one in thirty minutes. No technical training is necessary. Accuracy is reduced somewhat when using the beacon, but experimental work is being done to improve this.

Navigational safety is another feature of the radar. A recent trip was made by the writer when the boat ran forty miles in the dead of night, in a dense fog, to the Cameron, Louisiana jetties. The run was made at full speed with radar, weaving among other boats caught by the fog and anchored for the night. At the mouth of the jetties, speed was reduced to four knots and the boat proceeded to Cameron. This was a work-a-day run to the regular crew!

Figure 1: Types of aerial photographs.



This is the first of a series of two articles prepared especially for WORLD PETROLEUM by Messrs. Brundall and Wasem. The second part will follow in an early issue—Editor.

PHOTOGEOLOGY'S PLACE IN PETROLEUM EXPLORATION

Part I

By Laurence Brundall and A. R. Wasem*

PHOTOGEOLOGY, the technique of surface geological evaluation accomplished through aerial photographic interpretation, is now a standard exploratory method used by many oil companies. However, photogeology should be regarded only as an important exploratory tool, just as geophysics, core drilling and subsurface studies are also exploratory tools. A photogeologist is an experienced field geologist who has had special training in the use and interpretation of aerial photographs. The background of field experience is essential since it is only by continual reference to his knowledge of surface structural and stratigraphic conditions that a photogeologist is able to perform accurate photogeologic evaluation work.

Although photogeology was used to a limited extent before World War II, the technique has acquired new importance due to refined methods of photographic interpretation and photogrammetry developed during the recent war, coupled with a postwar need for more rapid exploratory methods. Many geologists who gained valuable wartime experience in the use of aerial photographs have applied this experience to their civilian work.

Photogeology is the ideal approach for preliminary exploration of large areas in which surface mapping is feasible, and it is being used today in all the actual and possible petroliferous provinces of the United States and in many foreign countries. Under optimum conditions these large areas can be mapped by photogeologic methods about three times as rapidly as the conventional field mapping methods and generally with a considerable saving in exploration costs.

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For a proper conception of the procedures and results of photogeology, a general discussion of aerial photographs and photographic methods is in order. These are briefly discussed as follows:

Types of Aerial Photographs: Figure 1 is a diagrammatic representation of the types of aerial photographs and photographic compilations. Photographs may be oblique (A and B) or vertical (C). A true vertical photograph is one made with a camera axis up to several degrees from the vertical. A composite photograph is taken with a camera having several lenses. The illustration (D) represents a common type in which a vertical lens is surrounded by four lenses at oblique angles. This type of camera is used in large area mapping, but the resulting photographs are not recommended for photogeologic evaluation because of the difficulties in using composite photographs for stereoscopic examination.

Aerial photographs are often compiled into mosaics or photo indexes. The photo index (F) is a rough compilation of all the photographs of an area laid down in the same order in which they were taken. Mosaics may be either uncontrolled or controlled, the latter being the most accurate compilation.

Flying an Area: Figure 2 shows the method of flying an area for the most effective coverage to give full stereoscopic vision of all the photographs. Individual flight lines should have a minimum of 15 percent and a maximum of 30 percent sidelap between adjacent flight lines, and each photograph in the line of flight should have a minimum of 50 percent and a maximum of 60 percent overlap.

Scale: As a rule of thumb, the larger the scale of the contact prints, the more geologic information it is possible to derive from them. However, a practical limit is placed on scale due to the fact that the cost of photography is proportional to it. Photographs, at a scale of 1/20,000 (approximately three inches equal one mile), which are adequate for most photogeologic work in low dip country, can be currently procured from commercial sources at prices ranging from $1.00 per square mile to $3.50 per square mile including photo index sheets at an approximate scale of one inch equals one mile. Government photography at the same scale costs about $.45 per square mile. The scale of an aerial photograph (Figure 3) is a function of the focal length of the camera lens

Figure 2: Flying an area.

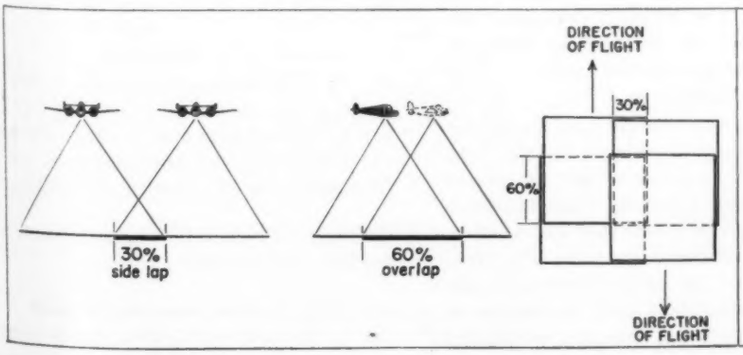
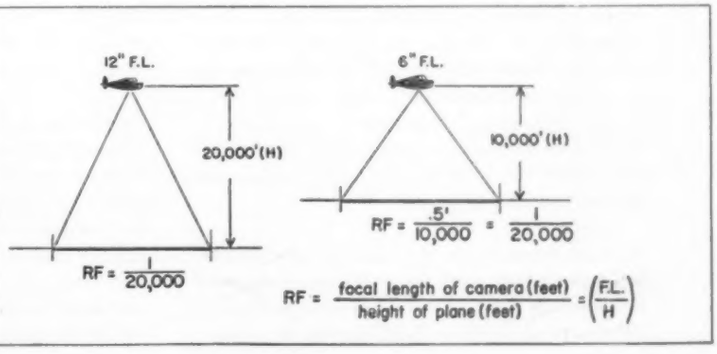


Figure 3: Scale.



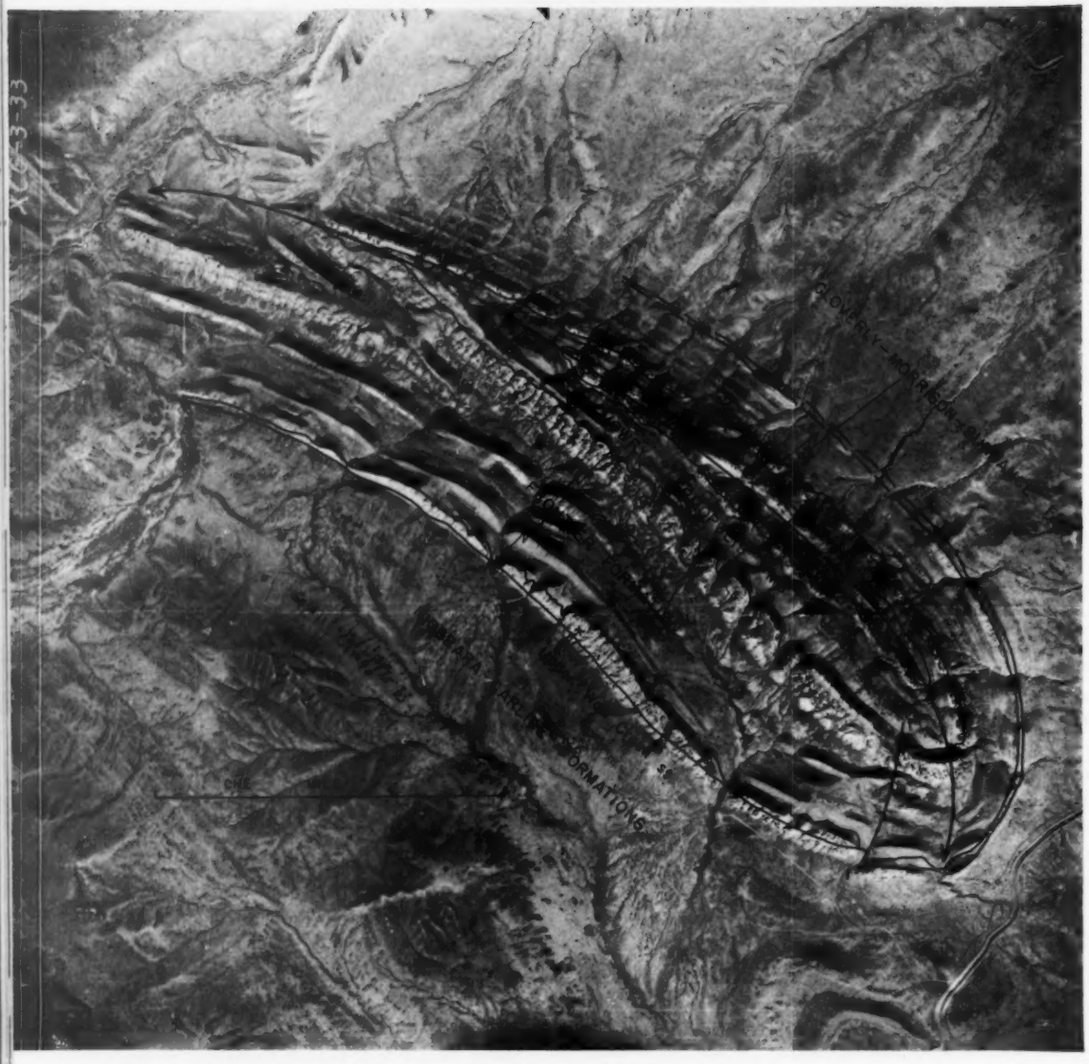


Figure 4: Oil mountain structure, Natrona County, Wyo. Photograph courtesy Aero Exploration Co., Tulsa, Okla.

and the height of the lens above the ground, i.e., the flight altitude above the ground of the photographic plane. A scale of 1/20,000 can be procured by using common lenses as follows:

Lens focal length	Height of camera above ground
5.25 inches	8,750 feet
6 inches	10,000 feet
8.25 inches	13,750 feet
12 inches	20,000 feet

Since a scale of 1/20,000 can be obtained with a 5¼-inch lens at a flight altitude of 8,750 feet above the terrain, it would seem desirable to use a short focal length lens rather than an 8¼-inch or 12-inch lens which would necessitate higher flight altitudes. However, the shorter focal length lenses, which are of the wide-angle type, produce photographs in which positive topographic features are considerably displaced radially from the center of the photographs. The correct planimetric delineation of geographic and geologic features on wide-angle photographs is made difficult unless the relatively expensive radial plot method of mapping is used.

Another disadvantage of wide-angle photographs for photogeologic work lies in the concave, bowl-shaped image which is seen when successive prints taken over an irregular land surface are viewed under a stereoscope. This is a serious hazard when working in low-dip areas, since it is extremely difficult to recognize the true attitude of the rocks under such conditions.

A lens of 12-inch focal length is in the semi-telephoto class for a photo coverage of 9 x 9 inches. When photographs taken with a 12-inch lens are viewed stereoscopically, the terrain appears more natural, but some of the relief exaggeration obtained with shorter focal length lenses is lost.

Photographs taken with a lens of 8¼-inch focal length are recommended as best suited for photogeologic work. The necessary flight altitude, 13,750 feet above the terrain, can easily be reached by modern photographic planes.

In addition to its use in areas of extensive surface outcrop, photogeology is of value in large area regional studies by means of trimetrogon photographs and in areas such as the Texas-Louisiana Gulf Coast in which geomorphic studies often provide clues to structural anomalies. However, the latter type of evaluation deserves separate treatment, so this article is confined to a discussion of the procedures and techniques used in the photogeologic construction of areal geology and structural contour maps in areas of extensive surface outcrops. A brief description will also be given of photogeologic evaluation using trimetrogon photographs.

The "text-book" structures so common in the Rocky Mountain region and other steeply folded belts are well known to all geologists, and Figure 4 illustrates the ease with which this type of structure can be mapped on aerial photographs. In the United States such structures were generally mapped 20 or 30 years ago, and the role of photogeology today is more concerned with the evaluation of less obvious structural conditions.

The objectives of a photogeologic evaluation are similar to the objectives of conventional field mapping, but the procedures used in arriving at the end result are quite different.

These objectives may be summarized as follows:

(1) The delineation of persistent stratigraphic units, formational contacts and outcrops of igneous rocks.
(2) Plotting of the attitudes of the sediments within the area.
(3) The geologic, geographic and cultural data obtained from the photogeologic evaluation compiled in a suitable base map on which the land units or geographic coordinates are shown.
(4) A final interpretation of the structure and stratigraphy of the area and a discussion of favorable structural anomalies as possible traps for oil or gas.

Figure 5 shows the operations flow chart used by Geophoto Services to consummate the four functions listed above. However, there are probably as many different methods of arriving at the final interpretation of an area as there are photogeologic consultants and photogeologic sections within the oil companies. The steps shown in the operations flow chart are as follows:

(1) Prior to the initiation of work on the photographs, an area is researched. This consists of examining all available literature on the area and abstracting all pertinent data concerning structure and stratigraphy which may be of assistance during the photogeologic work. Dry hole maps are consulted for the location of any tests drilled in the area.

(2) At the same time, suitable base map material for the final presentation of geologic data is being selected. In domestic areas base maps may be constructed from the following sources:

(a) General Land Office Plats
(b) U. S. Grazing Service and U. S. Soil Conservation Service Maps.
(c) U. S. Geological Survey topographic maps
(d) County highway planning maps
(e) Commercial maps (especially for Texas).

In foreign areas the following sources yield valuable base map material:

(a) U. S. Air Force aeronautical charts
(b) U. S. Coast and Geodetic Survey charts

(c) U. S. Hydrographic Office charts
(d) Maps and charts prepared by foreign mapping agencies.

(3) The preliminary photogeologic work is then undertaken, and simultaneously with this the base maps are constructed by the cartographic department.

(4) At the conclusion of the preliminary photogeologic work, the data are assembled in a preliminary photogeologic map which is reviewed prior to field check.

(5) At the conclusion of the field check, any necessary revisions and additions are made, and the final map is drafted and colored.

(6) A written report is prepared presenting the basis for the interpretations and the conclusions with respect to the area. This written report and final map are subjected to a detailed examination by a board of review prior to the submission of the map and report.

It is now proposed to examine these various steps in the photogeologic evaluation of an area in detail, considering the operations performed by the photogeologist and by the cartographic department separately, although such work is carried on simultaneously in the course of any given project, as is indicated by the flow chart.

Preliminary Photogeology: During the preliminary photogeologic work on any area, the photographs are viewed stereoscopically and are annotated with appropriate symbols showing the attitude of the sediments and the various stratigraphic units present within the area. Although several types of stereoscopes are available for this preliminary examination of the vertical aerial photographs, the ordinary refraction type pocket

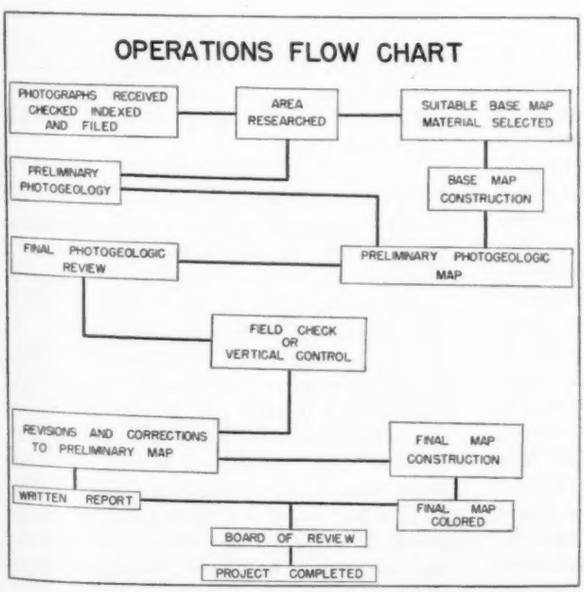


Figure 5: Operations flow chart.

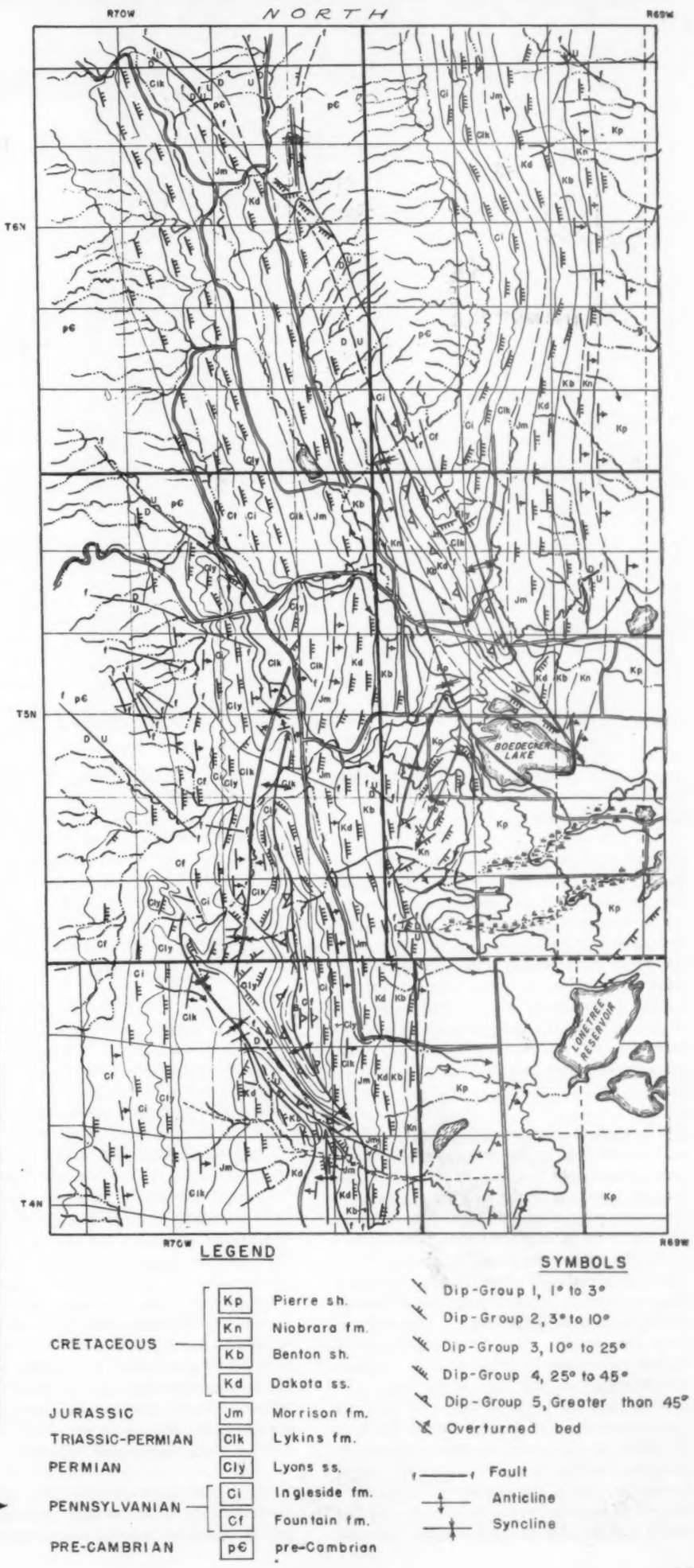


Figure 7: Areal geology and structural interpretation map of Loveland Area, Weld and Larimer Counties, Colo.

Figure 6: Uncontrolled mosaic of an area in Sweetwater County, Wyo.

stereoscope is preferred in that it gives a magnified view of the terrain, though the field of vision is somewhat limited.

Normal depth perception is accomplished through each eye viewing an object from a slightly different position, about 2¼ inches. Stereovision of aerial photographs works on the same principle, but instead of human eyes spaced a few inches apart, we have two positions of a camera lens with a separation of several hundred feet. To achieve the stereoscopic view of overlapping aerial photos we need: (1) two photos of the same area taken from different camera positions; (2) proper photo orientation; and (3) normal binocular vision.

Dip Estimation: Estimating the dip of inclined sedimentary beds by stereoscopic examination of aerial photographs is a difficult process which is entirely dependent on the skill and experience of the photogeologist and the near absence of tip and tilt in the aerial photographs. Dips observed under the stereoscope invariably appear steeper than their actual inclination. This is, of course, a help in extremely low-dip country but a source of confusion in areas where dips are steeper. However, dips ranging from three degrees to 20 degrees can usually be estimated with a reasonable degree of accuracy. Dips in the range of 20 to 45 degrees should be estimated with an error of no greater than five degrees, whereas dips from 45 degrees to near vertical are difficult to estimate closer than within 10 degrees of their true value. Low-order dips in the one-degree category are difficult to visualize, but if the beds are exposed over a sufficient distance and if proper attention is given to drainage patterns and drainage slopes, in most cases the photogeologist can determine the direction of dip with a reasonable degree of accuracy. The field check of an area is of great value in that it gives the photogeologist an opportunity not only to check his dip determinations but constantly to compare the relationship between the view of inclined strata obtained through the stereoscope and their actual attitude as observed on the ground.

Simultaneously with his estimation of dip on the aerial photograph, the photogeologist is delineating the stratigraphic units present, and where necessary or desirable, as many intraformational key units as can be followed. If the photogeologist is working an area in which he is unfamiliar with the stratigraphic units, he is provided through his research work with data concerning the stratigraphic divisions and the nomenclature. In general, the boundaries between stratigraphic units are readily discernible, but in certain areas, formational boundaries which are described in the literature cannot be identified on the aerial photographs. In such cases the photogeologist traces as many persistent units as can be observed on aerial photographs, and these are tied into the described stratigraphic section during the field check. The photogeologist in making his stratigraphic determinations uses all possible clues in following the units, such as their topographic expression, tonal changes on the photographs and, in many cases, vegetational differences.

In many areas structural and stratigraphic information which is not readily evident on the ground is obvious on aerial photographs. Figure 6 shows an uncontrolled mosaic covering an area in northern Sweetwater County, Wyo. An anticline in surface beds of the Wasatch formation is clearly defined on the aerial photographs, yet this feature is difficult to observe on the ground because of the presence of a thin mantle of playa deposits and gravels which obscure the Wasatch sediments.

In addition to the dip estimations and stratigraphic delineation, the photogeologist indicates on the aerial photographs faults, axes of folding, large areas of mantle cover or alluvial fill, as well as all pertinent geographic and cultural information such as roads, trails, streams, dams, pipelines, buildings and fence lines.

For ease in transferring the geologic, geographic and cultural data from the contact prints to a base map, the entire area of each alternate print in a flight line is annotated rather than half of each successive print. Upon completion of this preliminary photogeologic work on the contact prints, the photogeologist is faced with the problem of compiling this geologic data onto a suitable base map for field check and final presentation. One or more of the base map sources mentioned above may be used at this stage.

Ordinarily it is not feasible to transfer geologic, geographic and cultural information directly from contact prints to a base map. Consequently an intermediate compilation procedure is followed in which all data annotated on the contact prints are transferred to a mosaic such as those available from government agencies in much of Colorado, New Mexico, Arizona and Utah at a scale of one inch equals one mile. Similar mosaics at a scale of one inch equals 2,000 feet, 4,000 feet or 6,000 feet for areas outside the Rocky Mountains may be obtained from commercial survey companies, and these are also considered suitable as compilation media. After transfer of data from contact prints to mosaic, as many control points as can be identified, such as section or survey corners, section or survey line fences or roads, streams, road intersections and location of prominent topographic features are selected and identified on the mosaic and their proper positions noted on the base map.

Generally the geologic, geographic and cultural information annotated on the mosaic can be transferred directly to a base map at the same scale. However, should minor irregularities appear in planimetric control in the mosaic, the information can then be transferred to the base map by means of a projection machine which can be adjusted so that any group of control points on the mosaic coincides with the same control points on the base map. The planimetric error of a finished map prepared by this method will be well within the limits demanded by reconnaissance mapping. Experience has shown that the mapped position of any found section corner, almost without exception, falls within 300 feet of its true geographic position.

Figure 7 shows an areal geology and structural interpretation map of the Loveland, Colorado, area which has been prepared by the method described above.

OIL STORAGE THREATS ARE DISSIPATED BY RESULTS OF 1949 DRILLING

RESULTS of worldwide oil exploration in 1949 have definitely changed petroleum from a scarce commodity to one in plentiful supply now and in the foreseeable future. There is now a 30-year supply of oil in sight for the world's markets, and the trend is to increase rather than to decrease known reserves, J. Terry Duce, vice president of Arabian American Oil Co., told the annual meeting of the American Institute of Mining and Metallurgical Engineers at New York on Feb. 14.

In 1949 the petroleum industry in the United States broke virtually every record in the book. More wildcats were drilled than ever before. More development wells were drilled for oil and gas than ever before. More footage was drilled. New records for the deepest hole and the deepest producing well were set. Proven reserves rose to a new peak. Oil consumption set a new record in spite of unfavorable weather conditions.

Unfortunately, for the complete happiness of all operators, oil areas outside the United States were undergoing comparable development. A plentiful supply of oil almost everywhere bit deeply into the United States export trade and caused an increase in imports from flush areas in other countries. As a consequence, domestic producers were constrained to reduce their crude output as state conservation authorities issued proration orders to protect against losses in severance tax revenues which a break in the crude market would entail.

Early in 1949 a good many in the industry feared that lower grade crude prices would be the inevitable result of the warm 1948-49 winter and the disappointing fuel oil demand. There were some minor revisions in the prices of special crudes, but only in the Appalachian district, where the crude market is based on lubricating oils, was there any drastic revaluation of raw materials. In the Ohio-Pennsylvania-New York region the effect of crude price changes on drilling activity is strikingly seen. Drilling of service wells for flooding operations in this area declined 42 percent in 1949. In 1948 producers had drilled 2,040 input wells, and this number dropped to 1,170 in 1949. The reduction in wells drilled for oil and gas in the Appalachian region was almost as severe, amounting to 30 percent, when 1,135 fewer wells were drilled for oil and gas.

The American Petroleum Institute has not yet announced its annual survey of reserves as of December 31, 1949, but Albert J. McIntosh, economist for Socony-Vacuum Oil Co., told a recent meeting of the security Analysts Society at Boston that the figure may be about 1.2 billion barrels higher than a year ago. This would indicate a reserve of liquid hydrocarbons jn excess of 28 billion barrels in the United States at the end of 1949 or about 13 years' supply. Known reserves of liquid hydrocarbons outside the United States are on the order of 90 billion barrels, and these are increasing even more rapidly than are domestic reserves. Canada, for example, doubled its known reserves in 1949 and may possibly repeat the feat in 1950. Venezuela operators found eight new fields in 1949 and added substantially to reserves. Middle East reserves also were augmented by new discoveries and extensions of older fields. Seven new fields were discovered in Germany, and of these three are classed as major. Japan increased its reserves about 67 percent in 1949.

Because of its tremendous domestic demand for oil aggregating 2,133 million barrels in 1949, equalling 62 percent of the world's total demand of about 3,400 million barrels, the United States industry must perforce drill new wells at a rapid rate if it is to maintain adequate reserves. In 1949 wildcatting increased eight percent in the United States, exploratory wells rising from 6,728 in 1948 to an estimated 7,250 in 1949, according to the American Petroleum Institute. Although drilling was deeper and oil-finding is admittedly more difficult, the wildcatter's success ratio was about the same in 1949 as in 1948, roughly 15 percent. The API figures that the industry invested about $350 million in wildcats last year to find 1,400 new fields or pays. Average cost of a new find was thus $250,000. The Institute figure does not include the cost of land rentals and bonuses, geological and geophysical reconnaissance, site preparation, road building and the like. With these added expenses the cost of wildcatting rises to more than $1,000 million, and the cost per discovery to about $750,000.

Drilling for oil and gas (excluding service wells) in proven areas in the United States decreased slightly in 1949. The record was 30,400 wells in this category compared with 30,780 wells in 1948. As mentioned previously, the volume of drilling of service wells in the water flood areas in the east was reduced very sharply. In Kansas and Oklahoma, however, the development of flood properties proceeded at about the same rate as in 1948.

Texas was the center of drilling activity in the United States with 13,600 completions compared with 12,200 the previous year. Most spectacular area under development was the Scurry County reef area discovered in 1948 but largely developed last year. This is now classed as one of the largest fields in the oil history of the United States with known reserves up near a billion barrels. At the close of the year there were 296 producing wells, and step-out drilling was continuing to expand the productive area. With the discovery well only about 18 months old, the Scurry County reef now appears to have about four percent of the nation's known crude reserves.

The Cuyama area and other drilling in the San Joaquin Valley gave California operators a new lease on life after several disappointing years. The state was able to increase its reserves in 1949, a result not accomplished for some time past.

Geophysical activity in the United States was at a lower rate in 1949. On December 31 there were 432 crews in the field as compared with 519 at the close of 1948. About half of the decrease of 87 parties was compensated for by the increase in Canadian activity.

In neighboring countries both north and south of the United States drilling activity, both wildcat and development, was carried on at an accelerated pace. In Mexico 180 wells were drilled in 1949 compared with 83 the previous year. The Reynosa field was under rapid development with 20 completions. The Monterrey field discovered in 1949 and the new Mexican-American Independent discovery at Tortuguero are expected to be the scene of considerable drilling in 1950 as part of the Pemex program of 300 wells.

Vernon Taylor of Imperial Oil Ltd. told the AIME production review meeting that the 12 Canadian discoveries in Alberta in 1949 have doubled the known reserves of the Dominion and that further development is expected to make Canada self-sufficient before many years. Reserves are expected to rise to some five billion barrels. Canada needs about 320,000 barrels of oil per day, but in 1948 its production was not much more than ten percent of that volume. In 1949 this rose to about 59,000 barrels daily.

More than 100 oil companies now are taking part in the search for new oil in the Prairie provinces. At the end of the year 105 geophysical crews were at work, an increase of 44 during the year. Of the active crews 81 were seismograph, 23 gravity meter and one magnetometer. Since the new discoveries consist largely of reefs or formations over reefs, reflection seismic surveys predominate.

It is interesting to observe that the success ratio of exploratory wildcats in Canada was less satisfactory last year than it was in the United States. Mr. Taylor reported the following wildcat results for the year:

1949 Exploration in Canada

(Wells Completed)

	Total	Dry	Oil	Gas
New Fields	184	150	12	22
Outposts	18	13	4	1
Deeper Horizons	1	1	..	..
Total	203	164	16	23

(Please Turn to Page 90)

JAPAN'S OIL INDUSTRY

ENTERS NEW PHASE

By Steve Michael

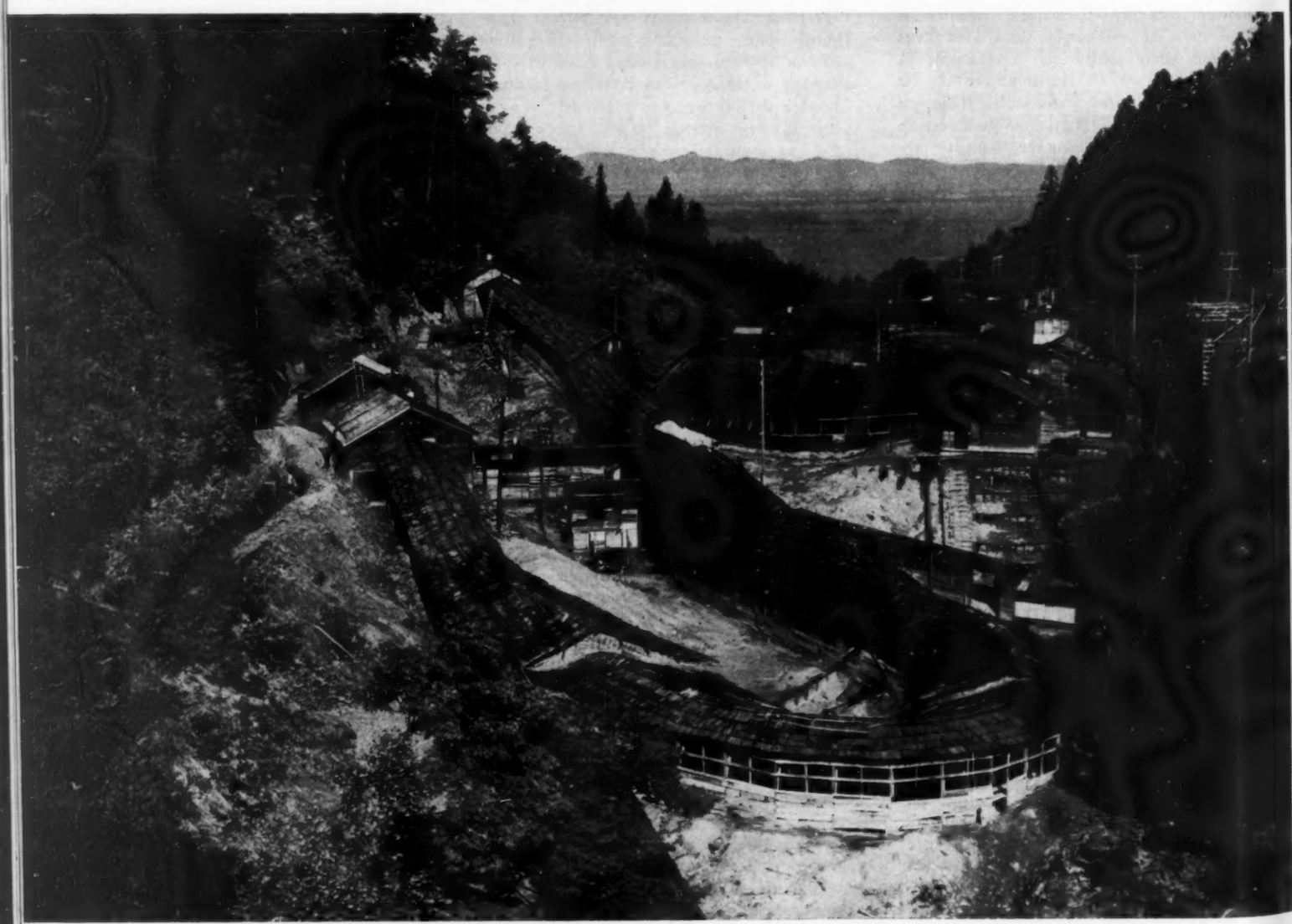
Tokyo

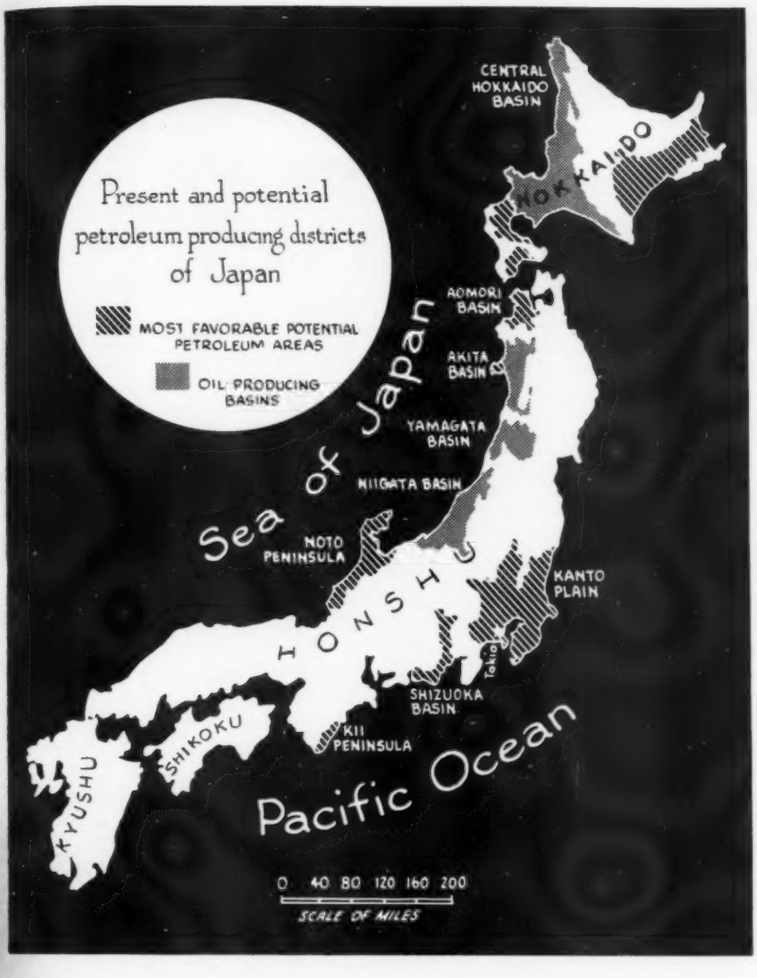
RESUMPTION of activity by the Japanese refineries after more than four years of idleness raises questions as to payment for necessary imports and, perhaps even more importantly, poses the problem of a possible increase in domestic production.

Since the end of the war Japan has been importing petroleum in the form of refined products under regulations established by the industry division of the military government. Several months ago permission was granted to reopen nine of the country's Pacific Coast refineries, and by January five of these were ready to start running crude and fuel oil. Initially these plants will handle about 600,000 barrels of imported oil monthly, but later imports will be increased to between 850,000 and 900,000 barrels monthly or about two-thirds of domestic requirements. Some fuel oil will continue to come in to meet industrial demands.

Aside from providing employment for refinery workers, the purpose of shifting imports from products to crude is to lessen requirements of currency exchange. Technicians of the industry division of the occupation authority estimate that this saving will amount to 77 cents per barrel or roundly $10 million during the course of

Japanese oil mine in the Niigata-Akita region where most of the country's petroleum is produced. The meandering roof covers a narrow gauge railroad used to remove rock and earth from the interior of the mine. Photographs with this article are by Girard for the U. S. Army.





Bamboo cable-tool drilling rig. Drilling had reached a depth of 300 feet when this photograph was taken.

a year. A far greater saving could be effected if the output from indigenous petroleum resources could be substantially increased. At present domestic production supplies only one-tenth of the market, and the yields of its small fields have been declining.

In 1948 the Japanese Ministry of Commerce and Industry estimated an ultimate total recovery of 105,411,000 barrels of oil from the country's 76 oil fields covering a combined area of 11,455 acres. Little more than half these fields were producing significant quantities of oil, and no field had an estimated ultimate production of more than 18 million barrels. According to the estimate of the geologists 80 percent of the total recovery would be derived from only 10 fields. Most of the country's producing fields were nearing depletion, and the number of producing wells was decreasing. That was the picture two years ago.

In recent months, however, some encouraging discoveries have brightened the outlook. These discoveries offer new hope for building an oil industry that can help meet the growing demands of a revived economy.

At Yabase on the northwest coast of Japan's main island of Honshu the Imperial Oil Company*, which had been exploring a new deep Zone VIII, struck oil at 3,800 feet. In the first 24 hours 272 barrels flowed from this initial well. Additional outpost wells drilled to the new zone indicate the area will be even more productive than originally anticipated. Earlier the company had been taking its oil from Zone VII at 3,400 feet where initial output seldom exceeded 150 barrels per day.

Geologists in General MacArthur's Natural Resources Section, who have assisted Imperial in developing Zone VIII at Yabase, estimate that the new deep zone's reserves total some 6,000,000 barrels, a formidable addition equal to 40 percent of the former proved reserve for the entire country. As a result of these added reserves, Japan might be able to cut her overall expenditure for oil imports by $20 million. Some 60 exploitation locations have been proved by the outpost drilling program at Yabase, and Japan's crude output rose from 3,800 barrels per day in August last to 4,500 barrels a day in October. Average output for the year was 4,000 barrels daily. Eighteen wells were drilled in 1949 and 12 producers brought in.

* Imperial Oil was established in 1941 by the Japanese Diet, with the government owning half its stock and private parties, principally Nippon Oil Co., holding the other half. The International Oil Co. (Standard Oil of New Jersey) acquired control in 1907 but later disposed of its holdings in Japan to Nippon Oil Co., according to SCAP's Natural Resources Section. The present Imperial Oil Co. controls more than 90 percent of the oil fields in Japan.

Another discovery that may further add to production was the finding recently of a large anticline parallel to the Yabase anticline. The newly discovered anticline may be as large a producer as Yabase itself, according to occupation geologists, and Yabase is by far Japan's most productive field, producing about 35 percent of the country's indigenous oil. Imperial Oil, which owns rights to the new anticline, is arranging to test the structure soon.

A new wildcat well at Toyotomi on the northern tip of Japan's northernmost island of Hokkaido also offers prospects of oil. Initially it produced gas at the rate of 313,000 cubic feet daily. More powerful drills were awaited to bore deeper and explore the possibilities of lower horizons. Objective of this test is 7,000 feet. Oil seepages have been discovered in eastern Hokkaido which holds a large Tertiary basin, and Tertiary embayments have been reported along the Pacific coast of Honshu which the geologists say, "warrant further investigation."

General MacArthur's petroleum experts point out that few test wells in Hokkaido's central basin have been drilled deeper than the Masuporo formation and that no record has been obtained of any wells which penetrated the Cretaceous. Although it remains to be demonstrated by exploration that Hokkaido's central basin contains petroleum reserves of economic

Producing face in an oil mine in the Niigata-Akita region of northwestern Japan. Niigata's fields formerly were the most productive in the country but today the Tabase field in nearby Akita produces 35 percent of the nation's oil.

significance, they advise, the area contains structures "which could offer wide possibilities if commercial production should be found in lower horizons."

In addition occupation geologists suggest other oil reserves may be found on northwestern Honshu, present center of petroleum production, through further exploration in:

(1) Hidden structures in mid-Miocene alluvial basins and in stratigraphic traps developed by unconformity or overlap around the margins of these basins;

(2) Basal Miocene horizons in many structures where these horizons have not been tested;

(3) Incompletely mapped marginal areas of main basins in Middle Miocene formation, where source rocks are still represented covered by gently folded younger sediments;

(4) Offshore production in mid-Miocene formations along the Japan coast;

(5) New fields of Upper Pliocene formations in alluvial areas, and

(6) New structures of Upper Miocene formations which contain the principal reservoir rocks of the petroliferous Tertiary. (Regional subsurface study of the distribution and variation in lithology of these formations was recommended.)

American geologists add that Tertiary basins in Japan outside of the main island also have potentialities for oil production "which appear worthy of consideration." The most important of these are in eastern and southern Hokkaido, southern Shikoku Island, southeastern Kyushu Island and the Noto peninsula.

Even if Japan is able to gain maximum or near maximum production from new deep zones, it still will be necessary to import a great part of the country's oil requirements. Thus the reopening of Japanese refineries and simultaneous importation of crude oil are regarded here as significant steps toward setting Japan back on her industrial feet. Last year the Standard Oil Development Company loaned the occupation the services of H. M. Noel, petroleum refining technologist, to assist in drawing up a rational plan for operating Japan's petroleum refining industry. The plan was drawn up, with its proposed initial crude allocation, was criticized by the Nippon Oil Company but was defended by an objective consideration of the facts Mr. Noel reported.

It called for five refineries on Japan's Pacific coast to be in operable condition by the first of this year. The Daikyo Oil Company plant at Yokkaichi will receive fuel oil and process into lubricating oils and asphalt at the rate of 1,000 barrels per day. The Nippon Oil Company refineries at Yokohama and Kudamatsu, the Showa Oil Company refinery at Kawasaki, and the Toa Nenryo Company refinery at Shimizu are each to be capable of processing 4,000 barrels of imported crude oil daily into a complete line of refined products. Their ratio of production is to be determined by domestic industrial needs.

A second phase of the program calls for rehabilitation of the Maruzen Oil Company refinery at Shimotsu and the Toa Nenryo refinery at Wakayama by next July 1. A production schedule of 3,000 barrels per day is anticipated

Estimated Product Delivery Schedule For Japan's Rehabilitated Refineries

(Figures in Thousands of Barrels per Month)

	March					April					May					June					Sept.				
	G	K	D	F	L	G	K	D	F	L	G	K	D	F	L	G	K	D	F	L	G	K	D	F	L
Yokohama	27	3	15	30	0	30	3	18	39	0	30	3	18	39	6	30	3	18	39	12	30	3	18	39	15
Kawasaki	24	3	12	30	0	30	3	18	39	0	30	3	18	39	6	30	3	18	39	12	30	3	18	39	15
Shimizu	24	3	12	30	0	30	3	18	39	0	30	3	18	39	6	30	3	18	39	12	30	3	18	39	15
Kudamatsu	0	0	0	0	0	30	3	18	39	0	30	3	18	39	6	30	3	18	39	12	30	3	18	39	15
Shimotsu	0	0	0	0	0	0	0	0	0	0	21	3	9	42	6	21	3	9	36	9	21	3	9	36	9
Wakayama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	6	27	84	0	57	6	27	48	18
Yokkaichi	0	0	0	0	0	0	0	6	18	3	0	0	6	18	3	0	0	6	15	6	0	0	6	15	6
Total	75	9	39	90	0	120	12	78	174	3	141	15	87	216	33	186	21	114	291	63	198	21	114	255	93

NOTE: In preparing this chart, Refinery Expert H. M. Noel specifies that the figures represent only "a conservative guess."

G—Gasoline, K—Kerosene, D—Diesel Oil, F—Fuel Oil and Asphalt, L—Lube Oil, Grease, Wax.

for the Shimotsu plant and 6,000 barrels daily for the Wakayama plant. Both refineries will process imported crude into refined products. Rehabilitation, but no immediate allocations of stock, also is to be permitted for Mitsubishi Oil Company's Kawasaki plant and Koa Oil Company's Marifu refinery.

With the exception of the Daikyo plant at Yokaichi, all the refineries are related "more or less," Mr. Noel points out, to some foreign oil interest. The two Toa Nenryo plants are the joint property of Standard Vacuum. The two Nippon Oil Company refineries are controlled jointly by Nippon and Caltex. The Marifu refinery also is a concern of Caltex which has a 10-year marketing agreement with the Koa Company. The Showa Oil Company has a joint agreement with Shell. Maruzen Oil Company's refinery is to a limited extent the concern of Union Oil of California which has a marketing agreement. Tide Water Associated holds joint ownership of the Mitsubishi plant. Standard, Caltex and Shell engineers are assisting in re-establishing the refineries in which their firms are interested.

Mr. Noel has recommended to occupation officials that a total of 4,815,000 barrels of crude oil be delivered before next July to the six refineries authorized to process it. He also recommended surveillance of oil industry control activities of the Japanese government, aimed at: (1) minimizing the outlay for refinery feed stocks, (2) improving the refinery output both in regard to percentage of valuable products and quality, and (3) minimizing capital outlays for imported refinery equipment.

The first consideration is to decrease the crude imports in meeting Japanese requirements. This can be done, the Standard specialist advises, by reducing fuel oil production and correspondingly increasing fuel oil importation. It involves installation and operation of the necessary refinery equipment to permit manufacture of the maximum possible percentage of lube oils in proportions required by the market, and reducing the crude import to the minimum amount necessary for this purpose. Concurrently it requires the production of cracked gasoline to supplement the virgin gasoline, so that market requirements of this product can be met with the limited amount of crude found necessary for lubes.

"The second consideration," Mr. Noel states, "requires that refinery fuel oil and loss be reduced to the figures representing efficient modern practice and that output of the various finished products be made to accord with the pattern of requirements even as regards the most difficult items. Solvent extraction of certain lube oils will be necessary to meet reasonable specifications. . . . Cylinder oils, especially locomotive cylinder oils, should be attempted as soon as means can be made available, and ice machine oils should be put on the program as early as possible."

The third consideration involves the supervision of refinery equipment design and construction that will enable Japanese firms to provide process units and repair parts, instruments and other required items in accordance with the best modern standards. It also involves engineering consultation "so that the most can be gotten out of existing facilities and the proper additions be made."

The program set forth by Mr. Noel covers the processing of a total of 25,000 barrels per day of Middle Eastern crude and 1,000 barrels per day of fuel oil. This amount of crude at 25 percent of yield of straight run gasoline will meet civilian requirements of gasoline cited by occupation authorities as 2,268,000 barrels for the 1951 fiscal year. The lube oil requirements, cited as 1,105,000 barrels, including grease and wax, would represent only 12 percent of the 25,000 barrels of crude per day.

Since cracking equipment at Wakayama is expected to start operations about July, Mr. Noel says it is assumed the yield of gasoline will be increased to 31 percent shortly thereafter and the crude requirements so far as gasoline is concerned will be reduced to 20,000 barrels per day. Then, unless the occupation forces decide to secure a portion of their requirements from Japanese refineries, only 20,000 barrels of crude would be needed by the refineries each day, and their allocations would be reduced 20 percent.

Mr. Noel adds, "It is inconceivable" that 18,000 barrels per day of crude would suffice, although this would require a lube yield of nearly 17 percent. But even this small crude allotment could be reduced still further if the more than 4,000 barrels of petroleum currently produced in Japan daily is increased. Occupation experts expect indigenous production to reach nearly 5,000 barrels per day in 1951.

"It is improbable, however," Mr. Noel concludes "that the increase in indigenous production would outstrip the increase in civilian consumption which may normally be expected." American geologists in Japan have agreed with Mr. Noel so far as to state that major oil discoveries should not be expected, judging by the country's geologic picture and past records of producing districts. They add, however, that important territories "undoubtedly remain," both within and outside of Japan's producing districts.

Cable "tool" drilling predominates in Japan.

Above: Pumping well in the Sankenai field on Hokkaido, Japan's northernmost main island. Lacking modern rotary equipment the Japanese have not tested deep horizons known to exist in this area.

SPEED KUWAIT TANK FARM AND TERMINAL OPERATIONS WITH ELECTRICAL CONTROLS

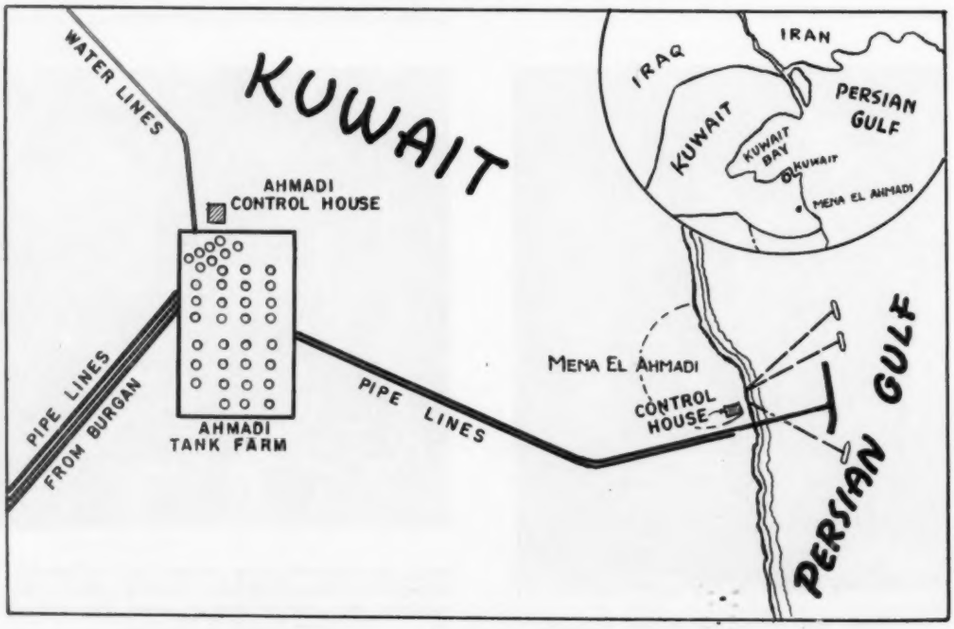
AN UNUSUAL system for electrical remote control and remote gaging at a large tank farm and marine loading terminal will soon be placed in operation. This control system is designed to speed the handling of large flows of oil with a minimum of delay and with a saving in skilled operating personnel.

Installation of the equipment is now being made by International Bechtel Inc. at the Ahmadi tank farm and the Mena el Ahmadi terminal of the Kuwait Oil Company Limited at Kuwait in the Persian Gulf. The control system was developed and engineered by Bechtel Corporation, San Francisco.

Oil from the producing wells at Burgan is gathered and transported through a system of pipelines to the Ahmadi tank farm where it is gaged and held until needed for loading. In the control house at the tank farm is an indicator panel built in the form of a plan or model of the tank farm, with remote tank level gages which show the oil level in each tank, and indicating lights which show the operating position of the filling and outlet valves on each tank. A similar plan layout on a smaller scale is incorporated in the bench type control board which is provided with control switches for the tank valves. The original design provided controls for thirty-eight 160,000-barrel tanks with room for future additional tankage if needed.

Each tank level indicator has a warning light mounted directly above it. This light glows when the oil in the tank approaches either the top or bottom of a predetermined operating range and thus warns the operator. An audible horn or bell alarm sounds whenever any warning light operates. A horn release button, conveniently located, silences the alarm without extinguishing the light and resets the alarm relays so that the alarm will sound when the next warning light operates.

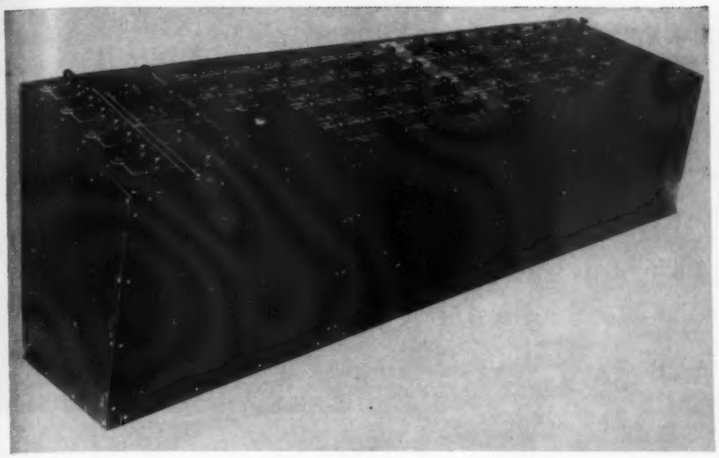
Map of area, showing relative locations of tank farm and terminal.



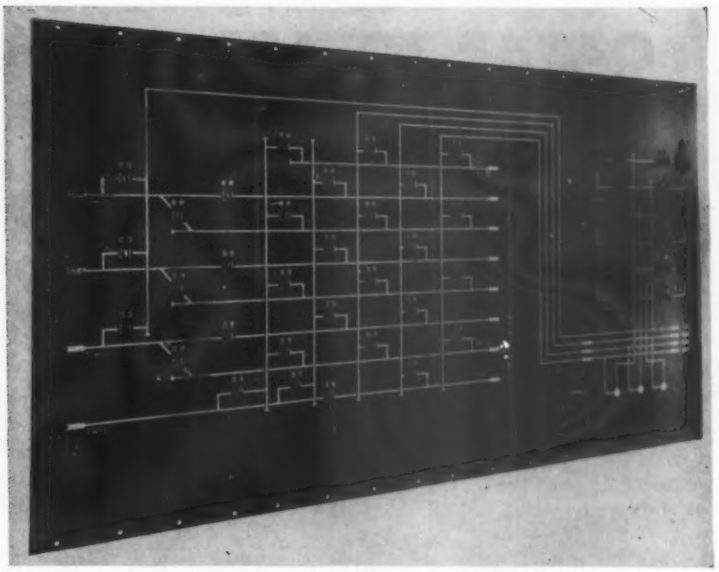
Four 24-inch pipelines connect the tank farm with the Mena el Ahmadi terminal some six miles away. Tankers can be loaded at a wharf which carries eight loading lines, or can be anchored at three offshore berths which are provided with submarine loading lines. In addition to the loading lines, there are provisions for six storage and transfer tanks at the terminal.

The incoming 24-inch lines, the eight 24-inch wharf lines and the connecting lines to the tanks and the submarine loading lines are interconnected by a switchgate manifold containing thirty-one 20-inch electric motor-operated gate valves. These manifold valves as well as the 12-inch inlet and 20-inch outlet motor-operated valves on the six transfer tanks are controlled from the terminal control house. The control board in this house is a single panel upon which are shown in miniature all the lines and manifold valves as well as the tanks and the tank valves. Control switches and position-indicating lights on the panel allow full operation of the the shore facilities from within the air-conditioned control room. Remote tank gages and alarms are provided for the shore tanks as at the tank farm.

Controls are electrically interlocked to prevent oil loss or diversion through misoperation. The inlet and outlet valves on each tank are interlocked so that it is impossible to open either one unless the other is tightly closed. The terminal manifold valves are interlocked so that flow from the tank farm through any of the four lines can be directed into any one of the loading lines, but it is impossible to connect one inlet line to more than one loading line or to connect one loading line to more than one inlet line. Thus, when a flow path is established, no portion of the stream can be diverted and no other stream can be introduced into the line. This interlocking is accomplished through the control relays and



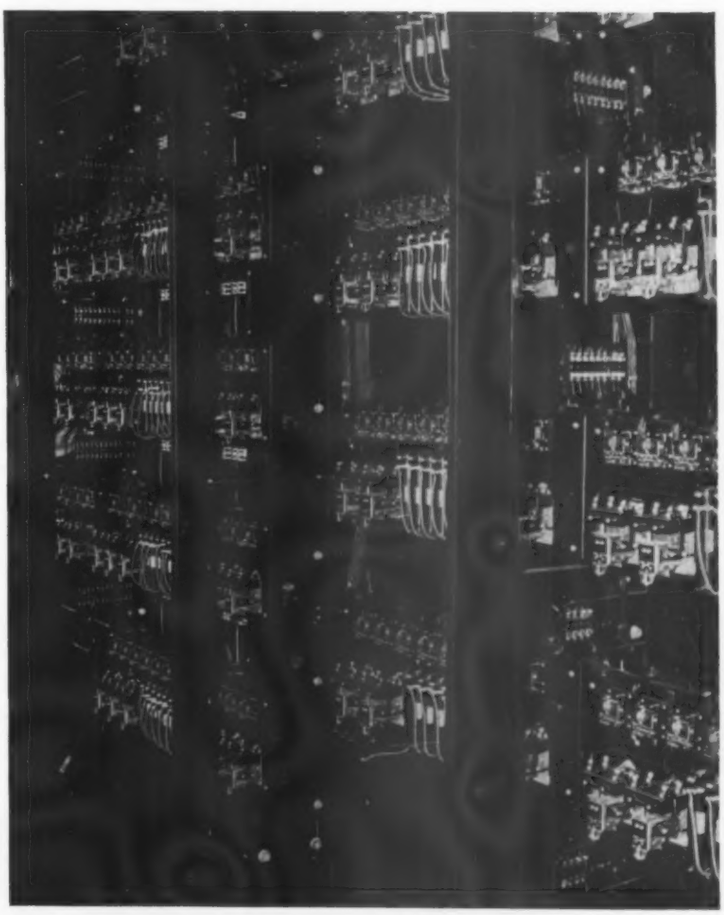
Shop view of bench type control board for Ahmadi Tank Farm.



Shop view of terminal control panel. Tank level indicators will be mounted in the holes at the right.

is designed so that failure of power supply or of any control or operating circuit cannot nullify the safety feature of the interlock.

All electric motor-operated valves are operated on 440-volt, 3-phase, 50-cycle power. At the Ahmadi tank farm the incoming power supply is received at 11,000 volts from an overhead line which supplies the entire area. Two centrally located substations are provided with transformers and secondary distribution switchgear. Underground feeders throughout the tank farm supply 440-volt power to the individual tank panels. The inlet and outlet valves on each tank are located near each other and are controlled by explosion proof reversing starters on the tank panel which is adjacent to them. Mounted on each tank panel is an explosion proof box containing the low voltage relays and pilot relays by means of which the valves are operated from the control house and the valve position indication is transmitted to the control house. Valve interlocking connections are also made at this panel. The valves may also be operated from the tank panel by means of convenient push buttons. The interlocks and remote indicators function whether valve is operated from the control house or the tank panel. All remote valve control and indicator circuits operate at approximately 24 volts DC and are carried in telephone type multi-conductor underground cables. Remote level-gage circuits operate on 110-volt, single phase, 50-cycle power and are carried in multiconductor underground cables.



Rear view of Tank Farm panel showing wiring and relays.

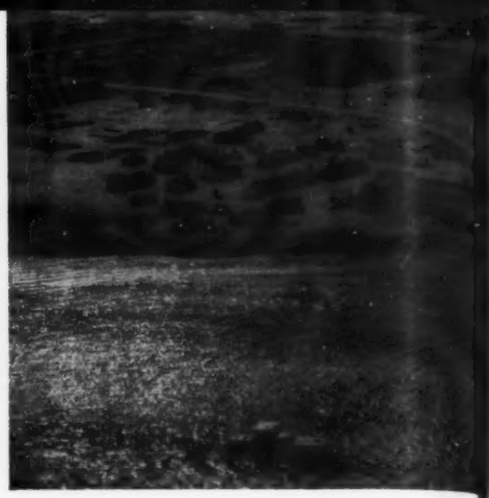
At the terminal the tank and tank valve controls are identical with those at the tank farm. The switchgate manifold is close to the control house, and, therefore, the 24-volt DC control circuits are not required for the manifold controls. In this case the reversing controllers for these valves, together with the interlocking relays, are located in a metal-enclosed switchboard in a switchroom adjacent to the control room.

To facilitate field installation and insure proper assembly the switchboards, control panels, relay boxes and portions of the tank panels were prefabricated, wired, tested and shipped as subassembled units. The tank-level indicators were shipped separately and will be mounted on the job. All field connections to the assembled units are made to marked terminal strips in the switchboards, panels and relay boxes. This procedure will minimize field wiring and testing and should facilitate any maintenance and trouble-shooting operations which may be necessary in the future.

The control panels at both locations, the bench board and the metal-enclosed switchboard were built to Bechtel specifications and drawings by the Chas. A. Langlais Co. in San Francisco.

The relay boxes were fabricated and assembled by the Nelson Electric Mfg. Co., Tulsa, Oklahoma, to similar specifications. Relays were supplied by Struthers Dunn and by Square D Co. The control switches and indicator lights were furnished by Westinghouse Electric Corporation. Tank gages and remote indicators were supplied by the Smith Meter Co., Los Angeles, California.

QATAR TO ADD 150 MILLION BARRELS TO MIDDLE EAST PRODUCTION IN 1950



COMMERCIAL production of crude was begun from Dukhan field on the Qatar peninsula in the Persian Gulf in the closing days of 1949. First off-shore shipment was made on December 31, and the field now is in normal operation on an ascending scale.

Development of the Dukhan field will add about two million long tons of crude to the Middle East supply this year (roughly 150 million barrels). Although beginning at a somewhat lower rate, the average production for the year will be about 40,000 barrels daily if available markets permit present targets to be reached.

Operator of the field is the Petroleum Development (Qatar) Ltd., a British corporation organized in 1936 to take over the 75-year concession granted by Sheikh Abdullah bin Qasim al Thani to the then Anglo-Persian Oil Co. Ltd. Ownership of Petroleum Development is identical with that of Iraq Petroleum Co. Ltd. in which a 23.75 percent interest each is held by Anglo-Iranian Oil Co., Compagnie Francaise des Petroles, Royal Dutch Shell and Near East Development Co. [Standard Oil Co. (N. J.) and Socony-Vacuum Oil Co.]. C. S. Gulbenkian has a five-percent interest.

First exploratory well in the concession was begun at the north end of the huge Dukhan structure in October 1938. It was completed in January 1940 as a 5,000-barrel producer. A second well drilled ten miles south of the discovery came in a year later with a similar producing potential. The two wells with well-head flowing pressures ranging from 342 to 367 psi, which were completed in the No. 3 limestone of the Zekrit formation, correlating with formations in Saudi Arabia, suggested that the Dukhan field is to be one of major importance. A third well to test the width of the producing section was drilled into edgewater in both No. 3 and No. 4 limestones 2½ miles east of the discovery. The threat of advancing German armies caused suspension of operations on the peninsula shortly after the third well was drilled.

Operations were resumed in 1947 and nine producing wells have been drilled. Commercial production has been delayed by the necessity of importing large quantities of equipment and the building of complete facilities for personnel and the installation of storage, a 73-mile pipeline and other field requirements.

The terrain of the Qatar peninsula is particularly unhospitable for a large-scale modern industrial development. The peninsula, which juts northwards into the Persian Gulf from its southern shores, has an area of roughly 5,000 square miles. The shallow seas which fringe its low, sandy and unattractive shores are filled with reefs, some of which merge above the surface at high tide, while others are permanently covered, and all render access difficult. The peninsula itself is flat and featureless and devoid of vegetation except for two or three struggling date gardens and a scanty scrub upon which camels can exist. The inhabitants, who total a few thousand, consist of dwellers in the four or five villages and of nomadic camel folk.

When operations were resumed in 1946, Petroleum Development employed some 200 locally, but today almost the entire employable population has been engaged in the oil operation. At the end of 1949 the company was employing 3,400 locally-engaged personnel.

To prepare for operations it has been necessary to import some 93,000 tons of equipment. Construction projects included complete housing, a hospital, an airfield and a port. All food and water must be imported.

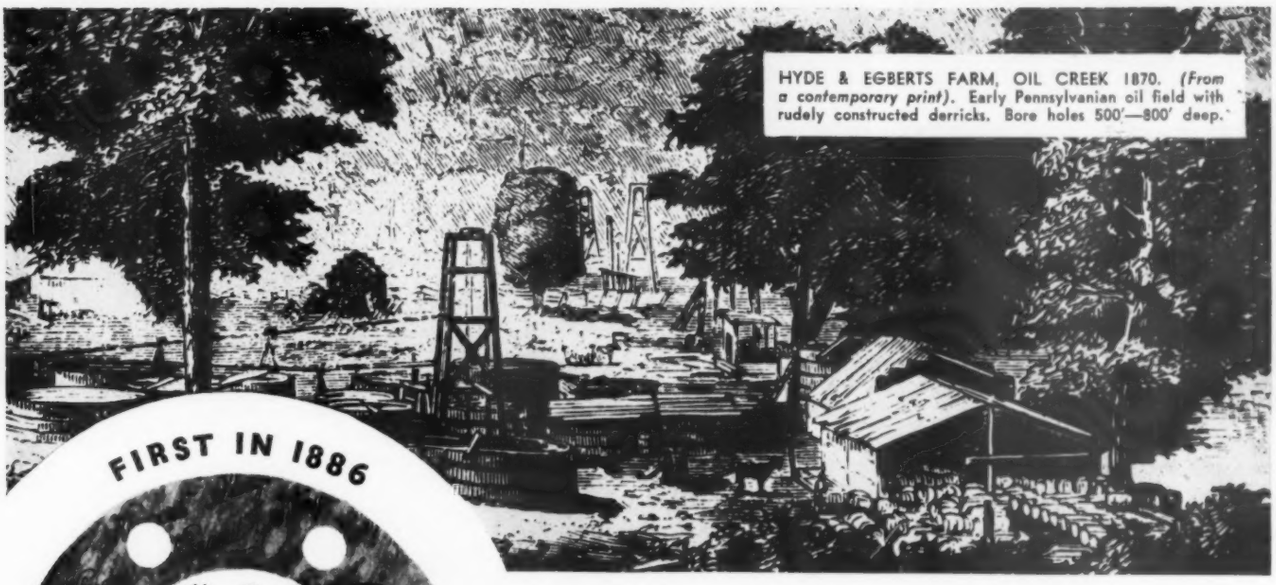
Because of the water shortage drilling operations have been conducted with sea water, necessitating the use of special drilling muds. Starch suspensions, Zoegel and soda ash have been employed, and Quebracho as a viscosity reducer. Fibrotex

Table I

Age	Local Name	Development	Thickness in feet
Eocene	Bahrein formation	Limestone with shales	1,000
Maestrichtian	Tayarat limestone	Limestone	600
Lower Senonian	Khatiyah formation	Limestones and shales	800
Cenomanian	Mauddud limestone	Limestone	200
Lower Cretaceous	Rutbah sandstone	Sands and shales	500
Cretaceo-Jurassic	Musandam formation	Limestones with subordinate shales	2,000
		Anhydrite	400
		No. 1 Limestone	35
		Anhydrite	30
		No. 2 Limestone	20
Jurassic	Zekrit formation	Anhydrite	50
		No. 3 Limestone	84
		Anhydrite	60
		No. 4 Limestone	133+

Well No. 8, Dukhan Field, Qatar.

The camp at Umm Said.



HYDE & EGBERTS FARM, OIL CREEK 1870. *(From a contemporary print).* Early Pennsylvanian oil field with rudely constructed derricks. Bore holes 500'—800' deep.

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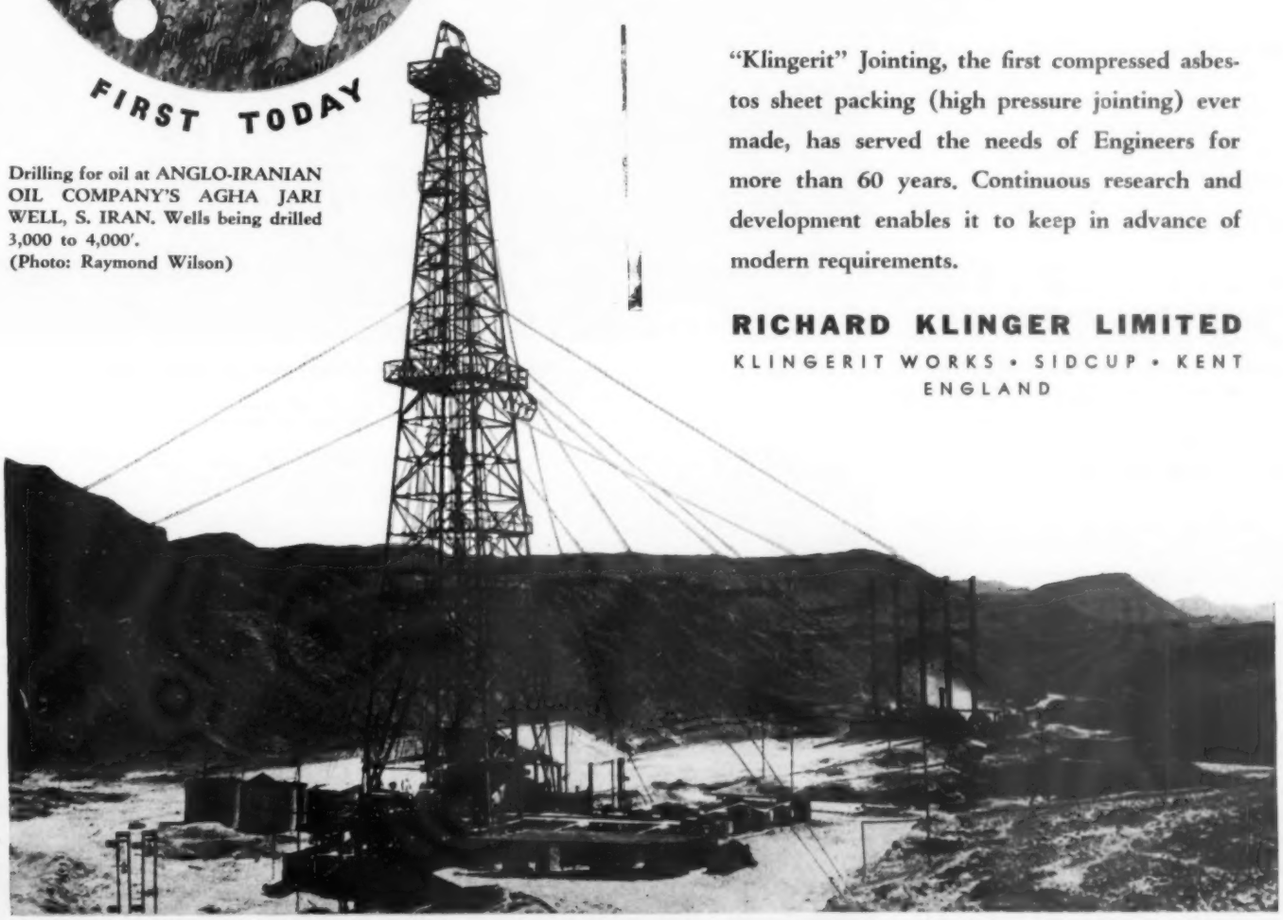

Drilling for oil at ANGLO-IRANIAN OIL COMPANY'S AGHA JARI WELL, S. IRAN. Wells being drilled 3,000 to 4,000'.
(Photo: Raymond Wilson)

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Zekrit Harbor on the west coast of the peninsula, through which much of the equipment was imported.

The Khatiyah degassing station.

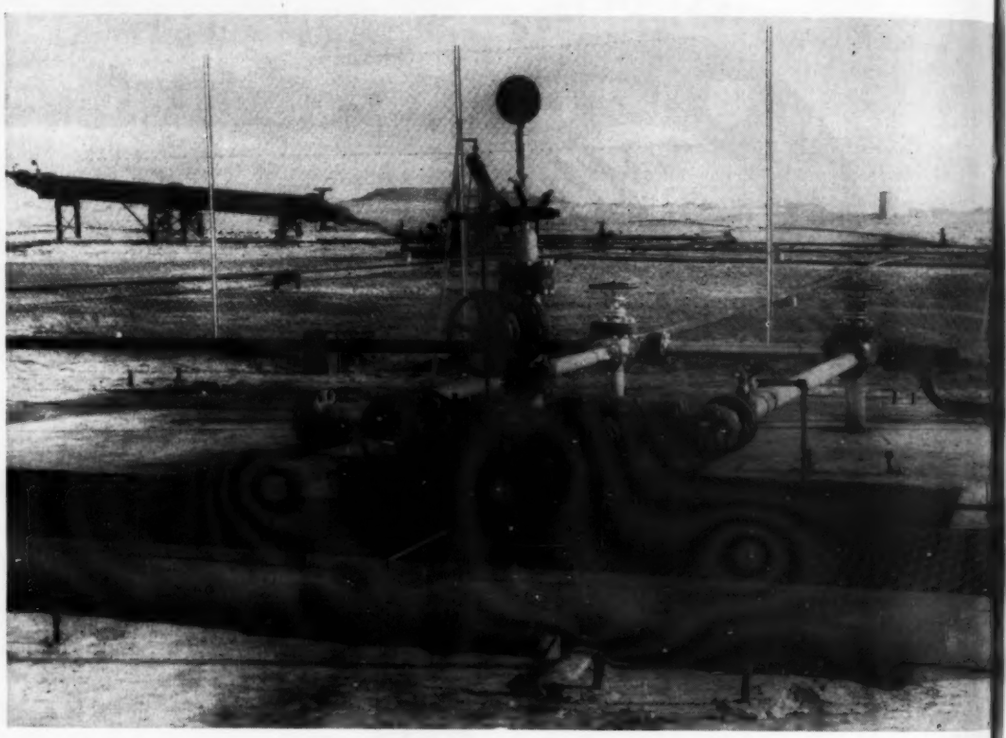
and Jelflakes are used as sealing media. A water string is cemented at about 4,000 feet in the Musandam formation, and an oil string in the 50 feet anhydrite above the No. 3 limestone.

Each well is equipped with a wellhead separator from which crude flows to a central multi-stage separation unit at Khatiyah, consisting of four horizontal separators operating down to atmospheric pressure. Adjacent to the multi-stage separation unit are two 30,000-barrel storage tanks from which the crude is pumped through 20 miles of 12¾-inch and 53 miles of 14-inch pipeline to the loading terminal at Umm Said on the east coast of the peninsula. A temporary pump station at Khatiyah is equipped with three slush pumps driven by Paxman diesel engines. At Umm Said are five 130,000-barrel tanks and five more, each of 148,000-barrel capacity under erection. From the terminal oil is loaded through two 4,200-foot double 16-inch sea lines.

The producing Zekrit formation lies at a depth of about 5,100 feet at the crest of the structure. Southward and eastward thickening of the overlying Eocene, Cretaceous and Cretaceo-Jurassic formations reduces the size of the Zekrit reservoir in comparison with the surface Eocene structure. The well-defined Dukhan anticline runs about parallel to the western shore.

Here surface elevations rise to 250 feet in comparison with elevations of from 120 to 170 feet prevailing over the remainder of the peninsula. Dips in the exposed limestones are very low, but elevations taken on marker beds revealed the presence of a surface anticline structure some 50 miles long and up to five miles wide with some 300 feet of closure. The geological succession established by drilling is shown in Table I.

With an important proven field under development and adequate facilities for exporting oil, the people of Qatar now are assured of a period of prosperity with schools, clinics and other amenities of the modern age provided by income from oil royalties and enlarged employment. Administration of the Sheikdom now is under the leadership of Sheikh Ali who became head of the state last August when his aged father, Sheikh Abdullah, abdicated after ruling for 45 years.



Typical well hook-up, with well-head separator in background.

Dukhan residential and industrial area.

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PEMEX PLANS 300-WELL PROGRAM TO INCREASE 1950 PRODUCTION

By Douglas Grahame

INCREASING oil production to 250,000 barrels daily is the aim of Pemex's 1950 program that will feature intensified exploration and more drilling than in any year of the half century of Mexico's commercial oil industry and of the 12 that the business has been nationalized. Senator Antonio J. Bermudez, Pemex's director general, wants to increase exports of oil and products as well as to provide a larger domestic supply. He announced that oil sales to Europe alone yielded $8.5 million (U.S.) in 1949.

Pemex expects $33 million from overall exports this year; $60 million in 1951 and at least $100 million in 1952. That contribution to sustaining Mexico's dollar stock and maintaining the foreign exchange rate at 8.65 pesos per dollar, is counted upon by Pemex from at least a 73-million-barrel production in 1950, of which 50 million barrels will be taken by the Mexican market and the rest exported. Pemex sources say 1949 was ended with an average daily output of 229,300 barrels of crude. This is a new high in Pemex history, though much below the peak of 193 million barrels yielded in 1921, heyday of the Tampico boom.

To attain the 1950 production goal a minimum of 300 new wells will be drilled this year. This compares with 180 in 1949, 83 in 1948 and 51 in 1947. Besides allowing much more oil for home use and export, drilling is looked to for an important increase in Mexico's oil reserves which Ing. Jorge L. Cumming, in charge of Pemex's geological services since 1941, estimates at close to 1,300 million barrels at the end of 1949, which places Mexico eighth in the world in that regard.

Pemex exploration this year will pay particular attention to the Gulf Coast where, according to conservative estimates of Mexican experts, there exists a vast amount of oil, perhaps double the 7,000 million barrels located and extracted in Mexico up to the end of 1949, according to Pemex statistics. Pemex said 1950 exploration has the encouraging backing of the discovery of 14 producing zones since 1948. Nevertheless, Pemex geologists this year will study other regions where oil has been indicated, such as the Continental Platform and Baja California. Saying that average daily 1949 production topped by 29,000 barrels the 200,000-barrel daily average Pemex expected, Sen. Bermudez named as toppers in last year's average daily output Poza Rica, 90,000 barrels; Panuco, 26,000 barrels, and the Isthmus of Tehuantepec, 20,000 barrels.

Pemex's 1950 costs budget will be the new high of 1,350 million pesos, Sen. Bermudez announced. For the first time, he made mention for publication of drilling done by the Mexican-American Independent group and by Gustav Wiegand. Up to Dec. 28 last, Wiegand had drilled seven wells in the Ebano zone, San Luis Potosi, of which six were productive and one dry. Wiegand has pledged himself to drill three wells this year. Sen. Bermudez expressed himself as being highly pleased about the 85.7 percent success ratio in 1949 but did not reveal how much oil the six wells are yielding. The Wiegand drilling is in shallow proven territory and at least some is essentially work-over of old producers which have declined to uneconomic levels.

Pemex is shopping for tankers to increase export facilities and sea servicing the Mexican market. A committee is now in the United States examining four tankers a private American company seeks to sell Pemex. The craft are Liberty type. Two of them are at Jacksonville, Florida, and the others at Seattle. If the committee approves the vessels, each of which is priced at $550,000, payable within eight years, the purchase will be made.

Pemex expenditures this year will feature exploration and drilling and completing the Salamanca (Guanajuato) refinery, the extension to there of the Poza Rica-Mexico City pipeline, and the pipeline from Coatzacoalcos (Puerto Mexico), on the Gulf Coast to Salina Cruz, Oaxaca, on the Pacific seaboard.

Pemex plans to build a shipyard at Tampico for the construction of ten tankers of 5,000 to 10,000 tons each. Pemex may invest 300 million pesos in this yard, and it has received building propositions from several American and European tanker builders.

The Transformation Industry Chamber has appointed a committee to visit Pemex fields and plants to determine just what machinery and equipment can be made in Mexico and arrange to provide Pemex with it, so as to free Pemex from importing replacements and even new items. Bermudez said he had appointed Carlos Alvarez Garcia, formerly Pemex purchasing agent in the United States and now serving in that capacity in Mexico, as his personal representative to accompany the commission.

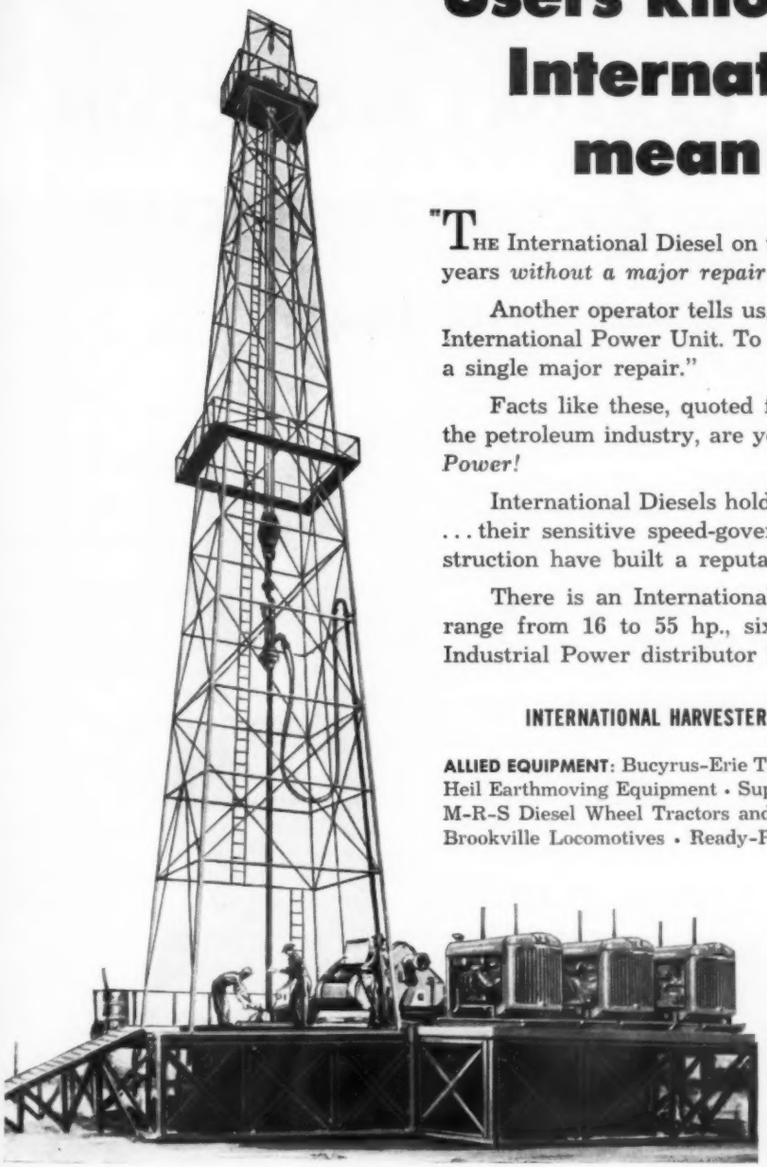
The federal government subsidy of 80 percent of the tax on oil to Pemex has been continued through 1950, the Ministry of Finance announced.

Though asserting that the future of the Mexican oil industry is virtually assured by increasing business on the home market and that putting into service new deposits discovered will provide increased production sufficient for that, Carlos Reynoso, Pemex subdirector of commercial activities, said that the gradual increase in oil consumption in the United States has caused Pemex to decide to maintain its foreign markets and

(Please Turn to Page 92)

Spudding in Tortuguero No. 1 on Oct. 13, 1949.

Users know— International Diesels mean Productive Power!



"THE International Diesel on this pumping installation has been working for 6½ straight years *without a major repair job!*" one user said.

Another operator tells us, "Neither the head or pan has ever been removed on our International Power Unit. To date it has given us 1095 days of 24-hour operation without a single major repair."

Facts like these, quoted from performance reports of enthusiastic users throughout the petroleum industry, are your best guide to efficient, productive power—*International Power!*

International Diesels hold costs to the minimum. They deliver full-rated horsepower . . . their sensitive speed-governing system, efficient lubrication, and overall rugged construction have built a reputation for superior performance and long-lived stamina.

There is an International for every oil field requirement. Five carburetor models range from 16 to 55 hp., six Diesel models from 39 to 180 hp. Your International Industrial Power distributor has the facts. See him today.

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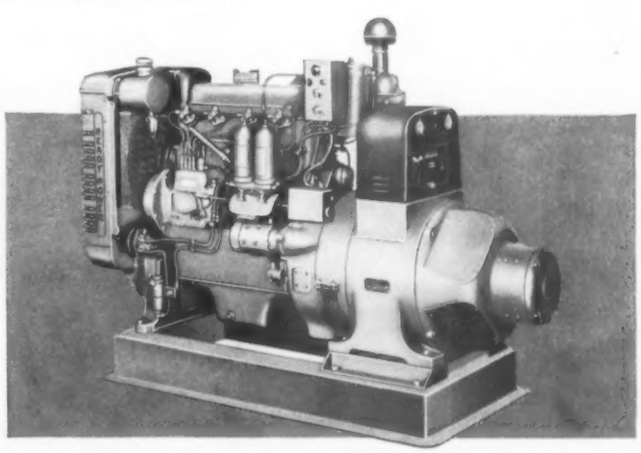

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Above: The exclusive International gasoline-conversion starting system gets these International UD-24 Power Units going fast on this drill rig. Such multiple units provide flexible, economical power.

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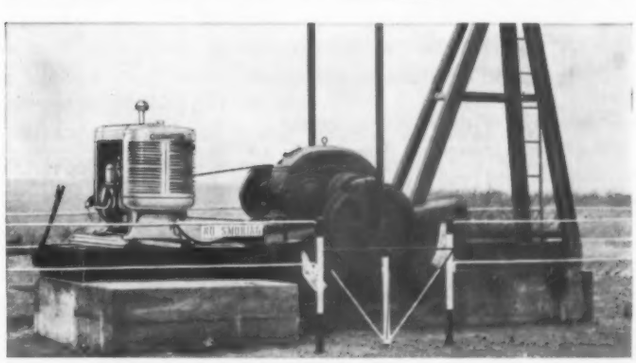
Above right: A complete range of sizes plus economy of International Diesels make Ready-Power Engine Generators popular choice for oil field electric power.



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Right: Continuous, dependable power from an International UD-6 keeps costs down and the oil flowing on this pumping installation.

INTERNATIONAL INDUSTRIAL POWER

INTERNATIONAL HARVESTER

CRAWLER TRACTORS
WHEEL TRACTORS
POWER UNITS

Opening separator line on Imperial-Leduc #3; Imperial Oil Ltd. Photo.

CANADA'S PRODUCTION GAINED 75 PERCENT IN 1949

By J. L. Irwin

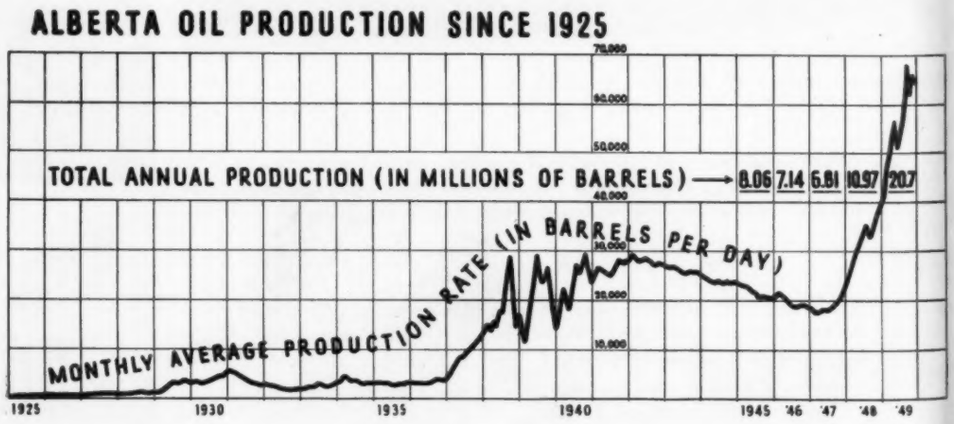
THE whole oil picture of Canada, perhaps of the North American continent, was radically changed in February 1947 by the discovery of the amazing Leduc field, 16 miles to the south of Edmonton, Alberta. Then followed Redwater some 18 months later, another amazing field and also near Edmonton, 45 miles to the northwest. Soon thereafter came Golden Spike, 15 miles west of Edmonton, possibly small in area but important because of wells with porosity of over 500 feet, capable of open flow production of 10,000 barrels daily. Good discovery wells were also brought in at Excelsior, 12 miles north of Edmonton; at Simmons, a valuable extension of Redwater to the southeast, south of the Saskatchewan River; and Normandville 30 miles south of the town of Peace River. Other productive areas of less spectacular performance also have been discovered.

It has been an impressive three years of development. For five years production had been declining in Canada's one important field in Turner Valley from its peak of 10,136,296 barrels reached in 1942. In 1947 the Dominion's total output was 7.7 million barrels; in 1948 it rose to 12.3 million and in 1949 it reached 22.1 million, almost double that of the preceding year. The gain of 15 million in the past two years was due practically in its entirety to the increase recorded in Alberta province.

Statistics such as those shown in the accompanying tables, impressive though they are, do not reflect the full impact of recent discoveries in the prairie provinces upon the oil situation, not merely in Canada but internationally. The reason is that, while vast potentialities for this western region have been revealed, its oil is still shut in. Oil requirements of all western Canada are a little over 60,000 barrels daily. Production since midyear 1949 has been limited to 65,000 barrels. If wells were permitted to operate at their full economic rate, the output would be perhaps ten times that amount. There is no point in letting production rise above the present daily quota because there is no place to put the oil, no economical means of transporting it beyond local markets.

Work is being pushed with all possible rapidity on the 1,200-mile pipeline that will, upon completion, be able to move some 70,000 barrels daily to deep water on Lake Superior, and tankers are under construction that can transfer this oil eastward to feed refineries in Ontario. No doubt, other pipelines will follow, and when the doors are open, the real oil boom in Alberta and Saskatchewan will get into stride with more refineries, more population and a great industrial development.

Meanwhile the groups holding leases and concessions will continue surveys and test drilling to determine the productive extent and the potentialities of their holdings, even though productive wells have to be shut in for the time being. With more than a hundred geophysical crews at work and more than a thousand productive wells in Alberta alone, western Canada promises to be one of the most active areas on the world's oil map, not only during 1950 but for years to come.



Canadian Crude Oil Production

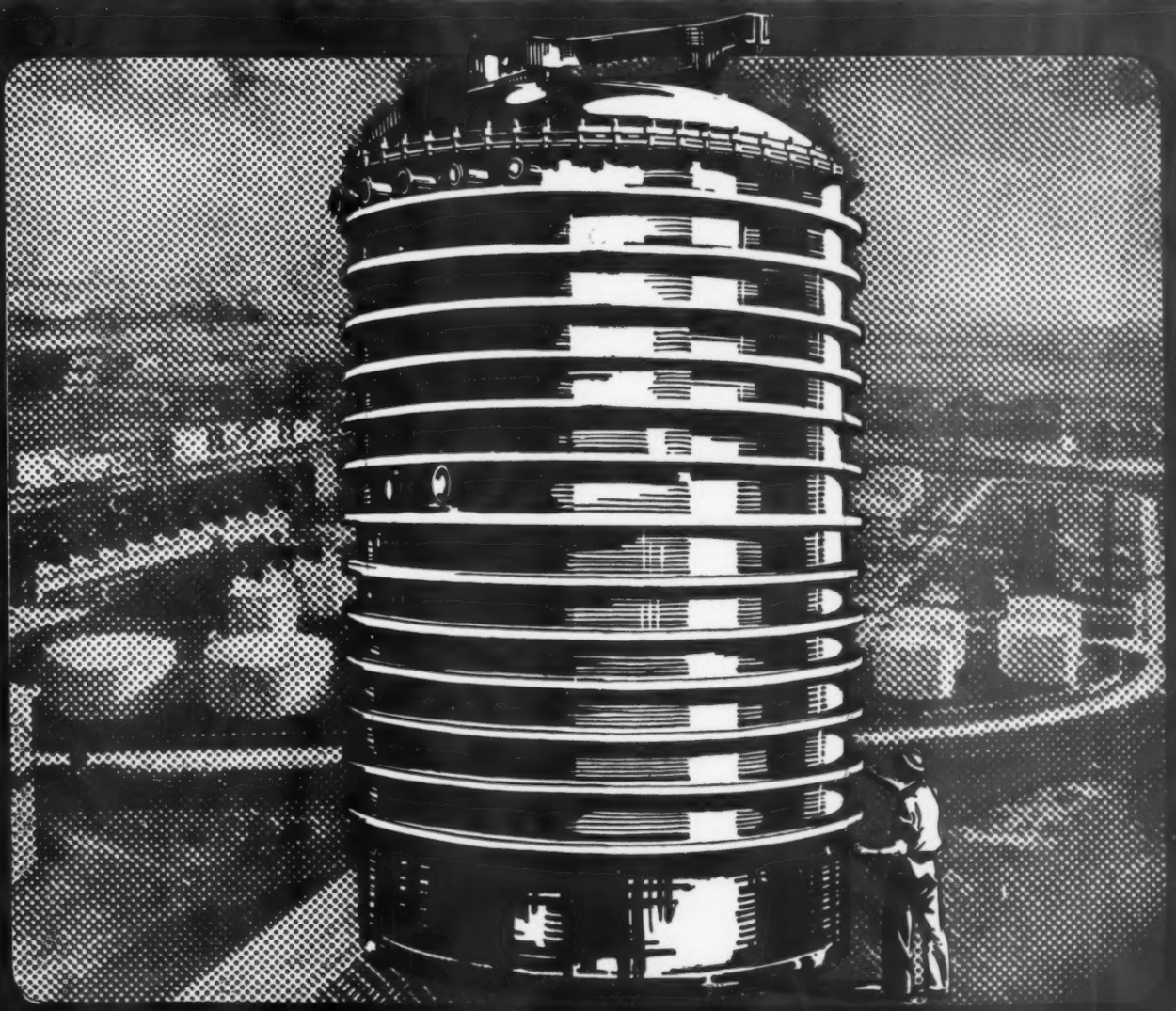
Province	1948 Barrels	1948 Valuation	1949 Barrels	1949 Valuation
New Brunswick	21,372	$ 29,920	19,600	$ 62,524
Ontario	176,989	608,109	265,000	922,000
Saskatchewan	849,166	976,541	800,000	800,000
Alberta	10,973,583	35,127,751	20,246,466	59,999,936
Northwest Territories	350,541	676,574	200,000	400,000
Totals	12,371,651	$37,418,895	21,531,066	$60,184,460

Production of Natural Gas

Province	1948 M.cu.ft.	1948 Valuation	1949 M.cu.ft.	1949 Valuation
New Brunswick	420,352	$ 287,446	371,000	$ 149,406
Ontario	8,590,429	6,958,247	7,929,433	6,422,841
Saskatchewan	477,271	47,727	610,900	44,015
Alberta	48,965,217	8,324,087	65,931,828	3,296,591
Northwest Territories	150,000	15,000	100,000	10,000
Totals	58,603,269	$15,632,507	74,943,161	$ 9,922,853

Note: Figures in the above tables are from the Dominion Bureau of Statistics and the Conservation Board of Alberta, except for the final month of 1949 which is estimated. Valuation of natural gas in Alberta for 1949 is made on a basis of five cents per mcf at wellhead.

Yours the problem - Harveys the answer!



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International News and Notes

N. F. Myers

Anglo-American Director Elected

Norval Franklin Myers has been elected a director of Anglo-American Oil Co. Ltd. He will be mainly concerned with Anglo-American's refining activities in the United Kingdom. Mr. Myers joined the Standard Oil Development Co., central research affiliate of Standard Oil Co. (N. J.), in 1941 as assistant chief engineer, after 16 years' experience in the petroleum industry as a research chemical engineer and in various manufacturing management capacities. For his services during World War II with the National Defense Research Committee, Mr. Myers was awarded the Medal of Merit by President Truman. Attached to the National Defense Research Council, Mr. Myers was chief of NDRC section 11.3 in charge of research and development of incendiary bombs and flamethrowers.

Anglo-American also announced that H. D. Demoulins, a director since 1947 when he came to New York, will remain in that city to attend to matters relating to the expansion of the company's refinery at Fawley.

1949 Venezuelan Production

Crude oil production in Venezuela averaged 1,321,367 barrels daily in 1949. This was a reduction of 1.3 percent from 1948 when the average was 1,338,794 barrels per day. Principal reduction was in the early months of the year when output dropped well below 1,300,000 barrels daily because of the fuel oil surplus. In preparation for a possible cold winter, producers stepped their production up above 1,400,000 barrels daily in the final four months of the year.

With the completion of large new refineries, the volume of oil processed in Venezuela rose 21.8 percent over 1948 to 52,990,000 barrels. This figure contains an estimate of December operations. Actual runs to stills through November 30 were 47,851,313 barrels. As a result of the expanded refining operations 10.99 percent of Venezuela's production was refined within the borders of the nation. This compares with 8.88 percent locally refined in 1948 and 8.46 percent in 1947.

Exports of crude from Venezuela totaled 384,866,047 barrels in the first 11 months, indicating a total of 423,234,000 for 1949 as a whole. Crude exports the previous year totaled 437,684,348 barrels.

Exports of refined products in the first 11 months totaled 32,792,384 barrels, giving an indicated total for the year of 36,995,000 barrels. If this total is reached, the increase in refined oil exports will be 17.9 percent.

Seven new fields were discovered during 1949 as follows: San Roque, Tamán, Ruiz and Punzón in the state of Guárico; Inca and Freites in the state of Anzoátegui; and Macoa in the state of Zulia.

Overseas Advisory Service

The Council of British Manufacturers of Petroleum Equipment has set up an Overseas Advisory Committee to aid members who are planning to go overseas or who may need information about overseas representation. R. L. Swan of Lincoln Electric Co. Ltd., one of the originators of the idea, is convener of the committee. A series of booklets is planned, one for each of seven areas: Middle East, Caribbean, North America, South America, South Africa, West Africa and Oceania.

Members of the individual committees are as follows: Middle East: R. L. Swan, Lincoln Electric Co.; E. B. Leach, Audley Engineering Co., Ltd.; C. Crossland, British Ropes Ltd.; P. D. Doulton, Matthew Hall & Co. Ltd., and H. Walker, Costain-John Brown, Ltd. Caribbean: R. M. Smart, The English Electric Co. Ltd.; C. G. Harris, Audley Engineering Co. Ltd.; F. H. Sullivan, A. Monk & Co. Ltd.; Dr. W. F. Riester, Sigmund Pumps, Ltd. North America: E. F. E. Howard, Hayward-Tyler & Co. Ltd.; S. L. Witard, The British Oilfield Equipment Co. Ltd.; and G. Hancock, David Brown & Co. Ltd. South America: Frank Kenyon, William Kenyon & Sons Ltd. and H. D. Walker, Costain-John Brown, Ltd. South Africa: G. H. H. Thorne, Dawnays Ltd. West Africa: C. Crossland, British Ropes Ltd. Australia, New Zealand, etc.: G. H. Thorne, Dawnays, Ltd. and L. B. Lambert, Zambra, Ltd.

New Production Record

Shipments of tubular goods by Stewarts and Lloyds Ltd. totaled 705,000 tons in 1949, a new record. In 1948 shipments were 560,820 tons, and the prewar record was 500,176 in 1937.

Santos Figueroa

All Mexican Seismic Crew

Plans made several years ago by Petroleos Mexicanos and Seismograph Service Corp. of Delaware (formerly Westby Geophysical Corp. in Mexico,) for the formation of SSCD seismic crews comprised entirely of Mexican nationals have been realized in the organization of SSCD crew MN-1 now operating in the Poza Rica area. All crew members attended the Polytechnical Institute of Mexico.

Party chief is Santos Figueroa, who served Pemex for 13 years in the Tampico offices as both a party chief and chief geophysicist. Other members are: Daniel Gutierros, chief computer; Armando Eguia, junior computer; and Salvador Reynosa, observer. Additional Pemex employees are now undergoing training in both the United States and Mexico and will be assigned to SSCD crews upon completion of the training courses.

Opens Quebec Terminal

British American Oil Co. has completed a new terminal at Chicoutimi, Quebec, which will receive shipments by tanker for distribution in the surrounding territory. Storage capacity of the terminal is 1,400,000 gallons.

Acquires Seisdel Business in Venezuela

Petro-Tech Service Co., Lane-Wells affiliate in Venezuela, has acquired all property and license rights of Seismograph Service Corp. of Delaware in its well logging and shaped-charge perforating business in Venezuela. Operations in Venezuela are under the direction of Russell W. Keener and Keith H. Miner, vice presidents of Petro-Tech. Securing Seisdel's well logging license will enable Petro-Tech to include radioactivity well logging among its services.

Venezuelan Production 1949

Daily Average in Barrels

Company	January	February	March	April	May	June	July	August	September	October	November	December	Annual Average
Creole	577,948	592,438	530,128	555,443	642,878	643,700	630,810	635,156	663,264	684,064	670,497	665.762	624,505
Shell	389,204	391,415	375,836	379,430	377,735	375,680	409,430	449,920	452,020	426,449	443,083	448,129	409,983
Mene Grande	177,001	149,171	145,545	159,743	164,750	163,819	144,709	168,413	180,072	192,211	193,913	189,672	169,191
Socony	32,077	33,029	33,946	34,512	35,234	35,194	36,875	37,791	38,279	36,799	39,043	38,459	35,951
Texas	21,095	16,257	24,174	22,102	21,398	21,506	24,646	20,272	24,928	27,603	27,091	28,601	23,357
Mercedes	15,169	14,501	15,025	15,345	15,754	15,145	15,259	15,398	15,969	15,774	16,803	16,931	15,581
Sinclair	17,672	17,485	16,759	15,962	15,580	15,408	14,633	14,216	13,734	13,552	13,913	13,533	15,190
Atlantic	10,154	8,791	9,220	9,024	10,009	10,409	11,946	12,146	12,920	13,622	14,492	17,286	11,692
Pantepec	.....	.....	.....	.....	.....	3,301	12,470	12,154	11,772	11,811	11,364	11,852	6,274
Phillips	1,852	1,836	1,913	4,138	3,717	4,641	4,413	6,586	7,293	6,621	7,389	7,668	4,852
Richmond	1,777	2,536	1,786	3,247	3,921	6,104	11,469	4,860	5,061	1,272	240	1,174	3,629
British	1,091	1,077	1,083	1,008	1,006	1,007	1,027	1,020	1,006	1,095	1,206	1,134	1,063
Guasare	.....	144	61	159	132	94	.....	98	118	138	130	122	99
TOTALS	1,245,040	1,228,680	1,155,476	1,200,113	1,291,934	1,296,008	1,317,687	1,378,030	1,426,436	1,431,011	1,439,164	1,440,323	1,321,367

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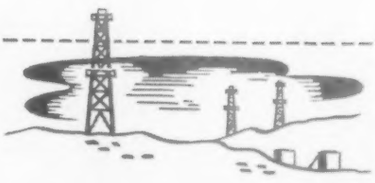
REPUBLIC'S formula for dependable service and analysis on each project combines thoroughly experienced personnel with fine precision equipment, thoroughly maintained.



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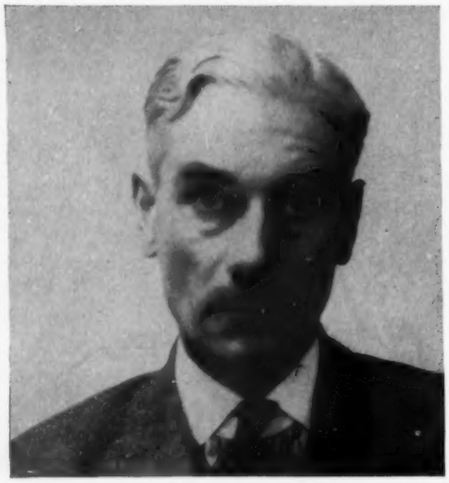
REPUBLIC EXPLORATION COMPANY

TULSA, OKLAHOMA **MIDLAND, TEXAS**



D. G. Pemberton

Haifa Appointment

D. G. Pemberton has been appointed superintendent at the Haifa plant of Consolidated Refineries Ltd. He succeeds J. Moffat who has been transferred to Belgium. Mr. Pemberton joined the Anglo-Iranian Oil Co. in 1930 and served in Persia until 1939. In that year he visited the United States and was afterwards posted to Haifa, where he became assistant refinery superintendent in 1947. He also served as Anglo-Iranian representative at the Eurotank refinery in Hamburg for a time in 1949, prior to his present appointment. Mr. Pemberton has an M.Sc. degree in chemistry, having studied at Victoria University, Manchester.

Exploration in British Columbia

Stimulated in part by the remarkable discoveries in the prairie provinces to the eastward, exploration for oil is assuming increased activity in British Columbia. Test wells are now drilling at two widely separated locations in the province, and upward of two million acres are under permits for surveys that will begin in the spring.

E. T. Kenney, Lands Minister of British Columbia, reports that Phillips Petroleum Company, drilling at Lone Mountain near the western Alberta border, in the Peace River district, reached Dunvegan sandstone at 1,250 feet. This is the same formation which occurs in the oil-bearing areas of northwestern Alberta. Mr. Kenney's report says, "The drill penetrated this sandstone to a depth of 1,278 feet and there appears to be at least 18 feet of coarse sandstone with oil showings." The Phillips well was spudded November 13 and the sandstone formation encountered December 13.

This Lone mountain test is only part of the western Canada operation of the Oklahoma company, which has undertaken a search in some 1,200,000 acres in a dozen new crown reservations in northwestern Alberta. This new exploration boosts the Phillips' Canadian interests to about 6,900,000 acres. In addition to its own northwestern program, Phillips is an equal partner with Husky Oil and Refining Ltd. in a 4,700,000-acre area across southern Alberta and Saskatchewan.

Royalite Oil Co. Ltd. and Britalta Petroleum Ltd. spudded a well on Graham Island in the Queen Charlotte group on November 30. On December 13 the well was below 826 feet in the lower Cretaceous formation. On January 10, after cementing off water, the well was making hole below 1,684 feet, in a quartzitic rock formation. Progress was slowed at that point by cold weather and difficulty in keeping the rig thawed out.

Dr. John Knox is geologist in charge of operations at Lone Mountain. William Gallup is director for Royalite Oil Company. Royalite has extensive holdings in the Queen Charlottes and in the Gulf Islands in the Gulf of Georgia just off the southern British Columbia coast between Vancouver Island and the lower mainland region. Oil found in the Queen Charlotte or Gulf Islands would be of more immediate importance than a find in the remote interior because of the proximity of shipping facilities.

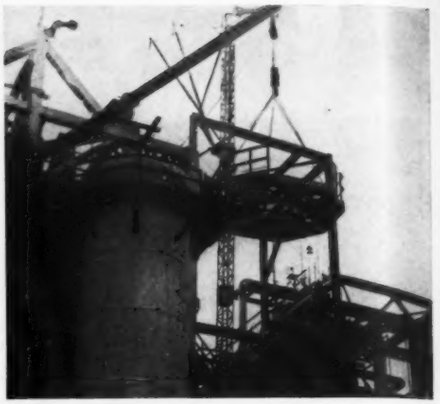
Areas under permit for exploration in British Columbia as of Nov. 30, 1949, were as follows:

	Acres
19 active geological permits	1,901,780
19 active geophysical permits	432,000
28 leases under former Act	23,047
Total area included in active stages	2,369,571
Area under application (4 permits)	355,880
Total area (Issued & applications)	2,725,451

Quick Turnaround at Berre Refinery

First catalyst change in the three-case Houdry unit of the Berre refinery of Cie. de Raffinage Shell-Berre in France was completed in January and put the plant in a position to resume operation, a development of importance since it is the only refinery in France capable of manufacturing aviation gasoline. The work was done under contract with the Catalytic Construction Co. of Philadelphia. Oliver Benoit supervised the task which was performed by French labor using specially designed tools shipped from the United States.

The Berre refinery was completed in 1939 just before the outbreak of war. During the German occupation

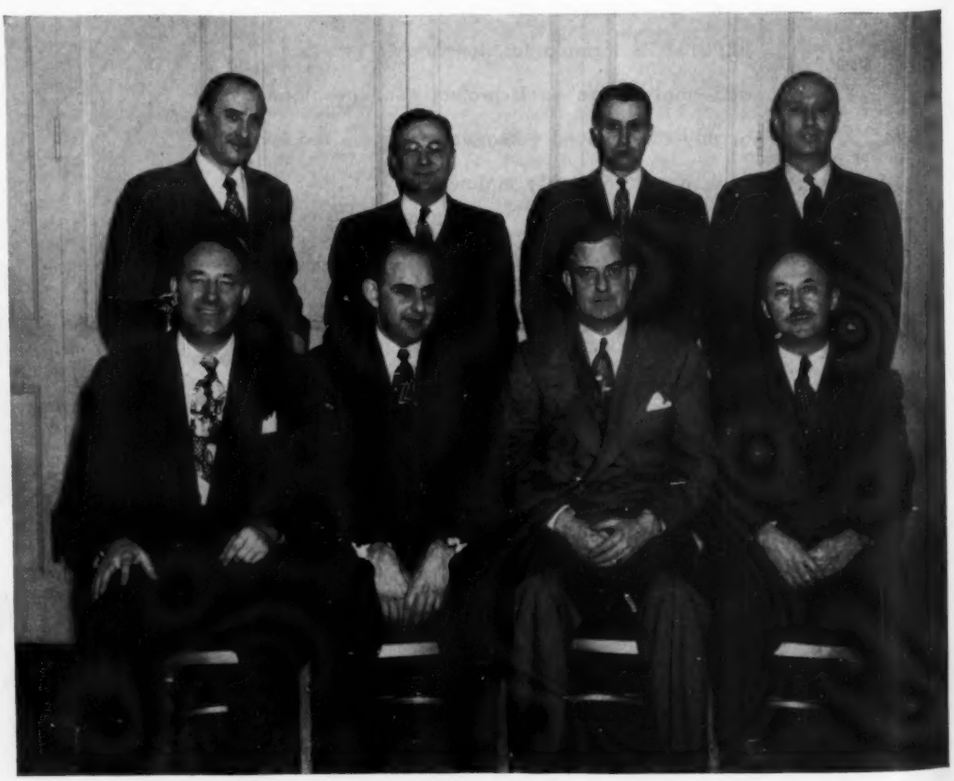


Lowering top platform from case, Berre Refinery.

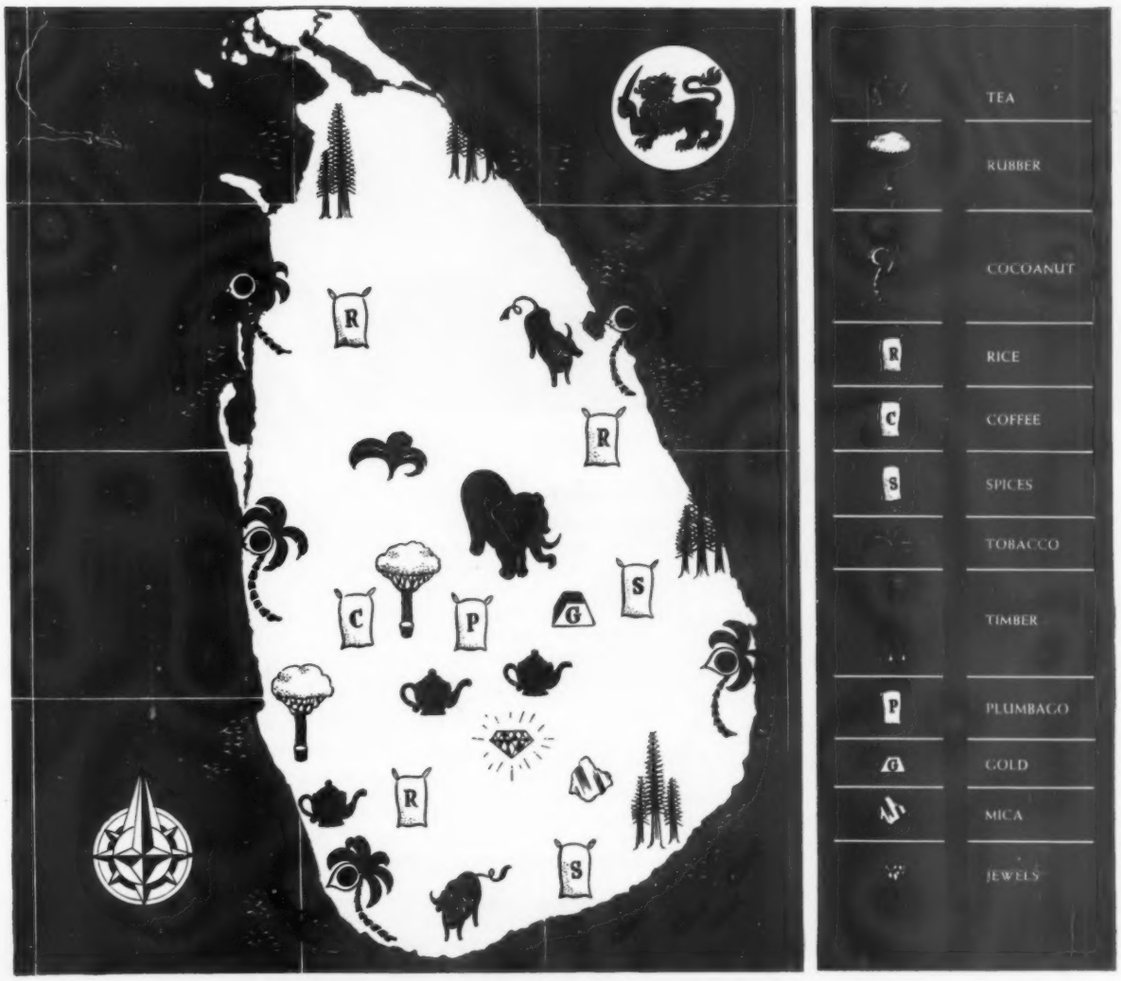
parts of the equipment were removed. Some of this was recovered after the war when reconstruction was undertaken in 1946, and the plant went back on stream in October 1947.

The cracking unit has a rated capacity of 5,200 barrels daily but has been operating below that figure because of lack of charging stock. A surprising feature of the turnaround was the perfect condition of the cases, despite the fact that the catalyst had remained unchanged for over two years. There was an entire lack of corrosion and choking, which contributed substantially to the rapid completion of the job.

F. A. C. GUEPIN has been appointed a director and managing director of the Anglo-Saxon Petroleum Co. Ltd. and the Shell Petroleum Co. Ltd. of London. He has also been appointed a member and a delegate member of the board of de Bataafsche Petroleum Maatschappij, The Hague. J. W. Platt, a member of the board of de Bataafsche Petroleum Maatschappij, has been appointed a delegate member of the board of the company.



Newly elected officers of the New York Chapter of Nomads pictured standing, left to right, are: Fred J. Jobst, assistant secretary; Eugene R. Smoley, assistant sergeant-at-arms; John D. Evans, assistant treasurer; Kenneth D. Demarest, sergeant-at-arms. Seated are: E. T. Landgraff, secretary; Maurice F. Delano, treasurer; Henry J. McAdams, president; and Howard B. Book, vice president.



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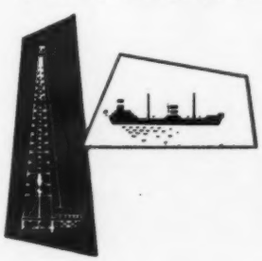
Standard-Vacuum is proud of the part it plays in supplying the petroleum products so essential to the welfare and continued growth of Ceylon.



STANDARD-VACUUM OIL COMPANY

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ISLANDS • SOUTH-WEST AFRICA • TANGANYIKA • THAILAND • UNION OF SOUTH AFRICA

Jack W. Askins

Opens Export Office

Jack W. Askins has been appointed manager of export sales for a group of companies manufacturing oil equipment. To direct export sales for the group he has opened headquarters at 233 Broadway, New York, and has arranged for local representation in some 30 countries where oil operations are most active.

Mr. Askins has enjoyed a wide experience in the merchandising of equipment to the international oil industry. He formerly was assistant general manager of the Central and South American district for American Rolling Mill Co., International Corporation Division. Later he was vice president of Armco Colombiana. During the war he served in the Aviation Base construction unit of the 21st U. S. Engineers, being discharged with the rank of Major. His military duties took him into the Africa, Middle East and Far East theatres.

The group of companies which Mr. Askins now is representing includes the following: Bettis Corp., Houston, Tex.; Big Four Machine & Supply Co., Clay City, Ill.; Davis-Lynch Sales & Eng. Co., Houston, Tex.; Delta Engineering Corp., Houston; Drilling Equipment Mfg. Co., Oklahoma City, Okla.; Longhorn Supply Co., Houston; Longhorn Machine Works, Houston; Pumprite Ltd., Houston; S. & R. Tool & Supply Co., Houston; Sales Engineering Co. of Houston, Inc., Houston; Sterling Packing & Gasket Co. Inc., Houston; and Thompson Pump Co., Okmulgee, Okla.

Stewarts and Lloyds Minerals Ltd.

From the beginning of this year all the mineral properties of Stewarts and Lloyds Ltd., the Stanton Ironworks Co. Ltd. and other subsidiary companies, and land associated therewith, were transferred to Stewarts and Lloyds Minerals Ltd. Directors of the company are: J. R. Menzies-Wilson, chairman; R. B. Beilby and A. F. Holden. J. McLaren is secretary.

Administrative office of the company is at Brigstock, near Kettering, Northants. The executive office controlling the operations of the company in Northamptonshire is at Brigstock. The executive office for operations in Leicestershire, South Lincs and Rutland is at Sysonby Lodge, Melton Mowbray.

The company owns 14,000 acres and controls 66,000 acres of ironstone bearing land in the Midlands. Its annual production of ironstone is approximately 4.5 million tons out of the total home ore production of approximately 13 million tons.

J. Moffat

Moffat Transferred to Belgium

J. Moffat has been transferred from Haifa to Antwerp where he has been appointed technical manager of the new refinery being constructed there by Petrofina and Anglo-Iranian Oil Co. Ltd. Mr. Moffat went to Haifa in 1941 as development superintendent. Previously he had served as chemist for Anglo-Iranian in Persia from 1929 to 1936 and later at the Courchelettes refinery in France. Mr. Moffat was educated at Glasgow University.

Ultramar To Increase Capital

The Ultramar Co. is taking steps to raise a further £1 million of working capital and has given the following details. The proposal is dependent upon the loan stockholders approving modifications of the rights of the unsecured stockholders, extending the directors' borrowing powers and increasing the capital to £3 million by the creation of two million additional shares of 10 shillings each.

Finance Corp. for Industry is to provide a further £250,000 which, together with the existing loan of £750,000 will be secured by a first charge of the company's present and future holdings of shares in Caracas Petroleum S. A. The remaining £750,000 will be raised by the creation and issue of convertible debenture to unsecured loan stockholders and ordinary stockholders at par.

Oil Find in South Oldenburg

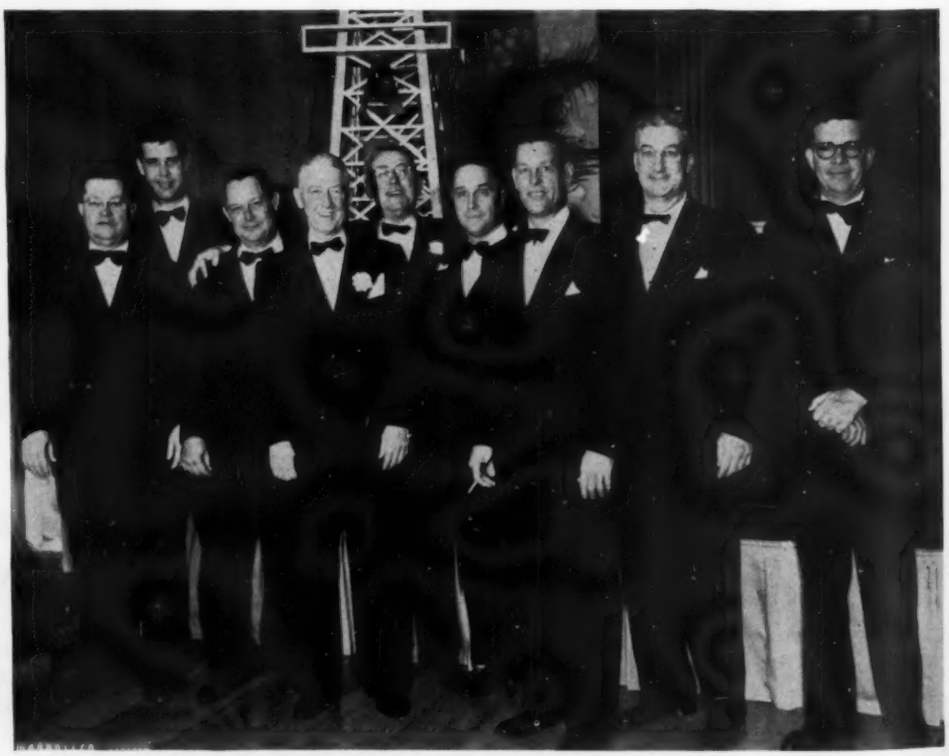
The wildcat well Quakenbrueck 5 near Quakenbrueck-Badbergen sunk by Oldenburgische Erdoel GmbH. (joint interest company of Deutsche Vacuum Oel AG and Gewarkschaft Brititta) struck a new oil deposit in the Lower Wealden-Serpulite at a depth of about 1,850 feet. The well flows crude with a high paraffin content. Details about quantities and analyses are not yet available. Quakenbrueck is situated east of the Emsland oil province (Dutch border) in an area where hitherto no oil was found. It constitutes a link between the Emsland and the Hanoverian oil district.

Authorizes Price Increase

Tropical Oil Co., Colombia, has been authorized to increase its prices on gasoline and kerosene three to five centavos per gallon, and on lubricating oils 15 centavos per gallon. The company had asked for increases about twice as large because of current losses.

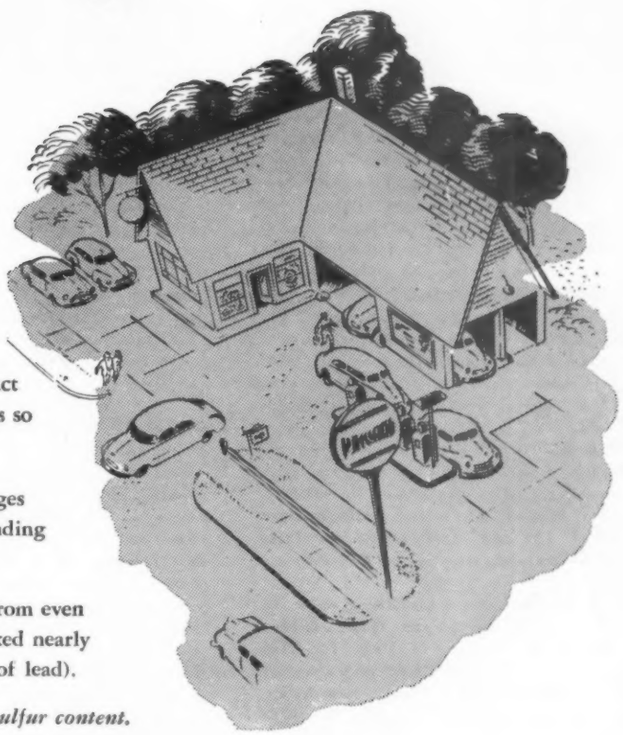
McCutchan Appointed Creole Treasurer

James H. McCutchan has been elected treasurer of Creole Petroleum Corp. to succeed J. P. O'Brien who has retired after 20 years of service. Mr. McCutchan went to Venezuela in 1937 as an accountant for Creole. In 1946 he was named chief accountant and in June 1948 operations manager of the marketing department. From December 1947 until his recent promotion he was assistant treasurer.



Houston Nomads installed their new officers at the annual Nomad dinner dance which was held at the Shamrock Hotel, Jan. 27, with more than 550 Nomads and guests in attendance. New officers for 1950 shown left to right are: C. B. McDonald, regent; Lawrence J. Kelley, sergeant-at-arms; Wayne Rives, vice president; Edmond L. Lorehn, president; C. F. Vincent, deputy sergeant-at-arms; E. F. Baldwin, assistant secretary-treasurer; E. M. Fontaine, regent; Tracey T. Word Jr., secretary-treasurer; and H. E. Estes, executive treasurer.

Thinking of gallonage?



Increased gallonage and product improvement go hand in hand. That's why Platformate, the product of the UOP Platforming process, is so important to refiners today.

It offers a combination of advantages available in no other gasoline blending component. For example:

High road octane. Platformate from even the lowest octane naphthas is rated nearly 100 (with the addition of 3 cc. of lead).

Inherently stable, negligible in sulfur content.
Pleasant odor.
More energy per gallon.
Economy of production.

That's Platformate . . . *your* way to make a better gasoline from even the poorest quality gasoline and naphthas. Result: Increased gallonage.

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OIL COMPANY STAFF CHANGES

John M. B. Howard

JOHN M. B. HOWARD, newly-appointed manager of Standard-Vacuum Oil Company's marine department, had extensive experience in worldwide marine operations before assuming direction of the 43 owned and chartered tankers that fly the Stanvac flag in the Far East. A graduate of the U. S. Naval Academy, Mr. Howard started as a deck officer on tankers in 1933, later received his master's papers and went on to important shore posts in key world petroleum ports. Before joining Standard-Vacuum in 1948 as assistant department head, he had been assistant general manager of Esso Transportation Co. Ltd. in London. Mr. Howard succeeds W. F. Dunning, who retired Jan. 1.

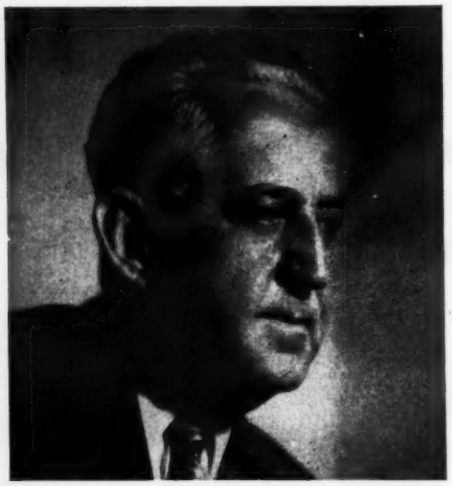
FLETCHER B. EMERSON has been appointed director of a training division within the industrial relations department of Continental Oil Co. He has been special assistant to L. F. McCollum, president, since November 1948. The new division will coordinate and broaden the training activities of the company.

DOUGLAS H. DYER, former advertising executive in the machinery and automotive parts fields, has been appointed advertising manager of Deep Rock Oil Corp., Chicago. He will direct Deep Rock's advertising program which includes new trademark design, color scheme and merchandising campaign for independent jobbers.

DR. IONEL J. GARDESCU and CURTIS MORRIS have been elected vice presidents of Transcontinental Gas Pipe Line Corp. Dr. Gardescu, formerly professor of petroleum engineering at the University of Pittsburgh, has been associated with a number of oil companies. He will be in charge of gas reserves for Transcontinental. Mr. Morris has been engaged in tax and legislative work in Texas, and for the past two years has represented the Governor of Texas in Washington, D. C., in the active campaign of the states to maintain their ownership of coastal submerged lands. He will be in charge of public relations for Transcontinental.

RICHARD BARD, formerly manager of Shell Oil Company's gas-gasoline department at Tulsa, Okla., has been made assistant manager of the crude oil department in charge of volatiles in the company's New York office. Mr. Bard has been replaced in Tulsa by Ruel Harris, a member of the crude oil department in New York for the past year.

B. I. GRAVES vice president of the Tide Water Associated Oil Co., has accepted the chairmanship of the petroleum division of the 1950 Red Cross Fund campaign of Greater New York. He will serve in the campaign section headed by Burl S. Watson, president of the Cities Service Oil Co.



A. A. Stambaugh

A. A. STAMBAUGH, since 1933 the vice president in charge of sales and a director of The Standard Oil Co. (Ohio), has been elected the senior vice president of the company. Mr. Stambaugh joined Sohio as director of industrial relations in 1928 when W. T. Holliday became president. He had practiced law in Cleveland from 1913 to 1928 with the firm of Holliday, Grossman and McAfee, then Sohio's legal counsel. After a year in industrial relations at Sohio, he became sales manager in 1929, and in 1933 was elected a director and vice president. He will continue in charge of all sales activities of the company.

CLIFFORD R. MOORE, superintendent at the Regina refinery of Imperial Oil Ltd. since 1940, recently retired after 33 years' service. He joined the company as timekeeper on the construction staff building the refinery in 1916 and fired the first crude still. He was successively employed as fireman, helper, stillman and shift foreman, all at Regina. In 1923 he was appointed assistant superintendent, becoming acting superintendent in 1936 and superintendent four years later.

He is succeeded by Ward O. Longworthy who joined the staff of Regina refinery in 1927 and was made assistant superintendent in 1947. William J. Beynon, who has been appointed assistant superintendent, has worked at the Sarnia refinery, at the Tropical Oil refinery, Barranca, Colombia, at Toronto and Calgary. Since 1947 he has been assistant to the operations manager, manufacturing department, at Toronto.

FRANK E. BUTTERFIELD, formerly chief clerk in Continental Oil Company's crude oil trading department, has been promoted to assistant manager of the department, which is headed by T. A. Van Grieth-huysen. Mr. Butterfield joined Continental at Ponca City in 1930. He served four years in the Navy during the war, terminating with the rank of commander in air combat intelligence.

PAUL J. HARRINGTON has been appointed assistant chief engineer by the Standard Oil Development Co. He succeeds N. F. Myers who has been elected a director of Anglo-American Oil Co. Ltd. Mr. Harrington joined what is now the Esso Standard Oil Co. in 1929 as a member of its technical service division and transferred to the Development Company in 1936.

JOE B. ALFORD of Dallas has been appointed executive secretary of the petroleum branch of the American Institute of Mining and Metallurgical Engineers, Chairman Lloyd E. Elkins of Tulsa has announced. He succeeds William H. Strang who resigned recently to affiliate with the American Petroleum Institute.

CLARENCE G. DAVENPORT, associated with The McCarty Co. of Los Angeles since 1930, and Willard H. Wilde, manager of McCarty's San Francisco office since 1939, have both been named vice presidents. Mr. Davenport is in charge of research and development of client plans and campaigns. He served as Captain in the Field Artillery, European Theatre of Operations with the Third Army in World War II. Mr. Wilde joined McCarty Co. in San Francisco in 1939 as an account executive, becoming manager three years later. Under his direction the staff has been expanded to render a complete agency service in all branches.

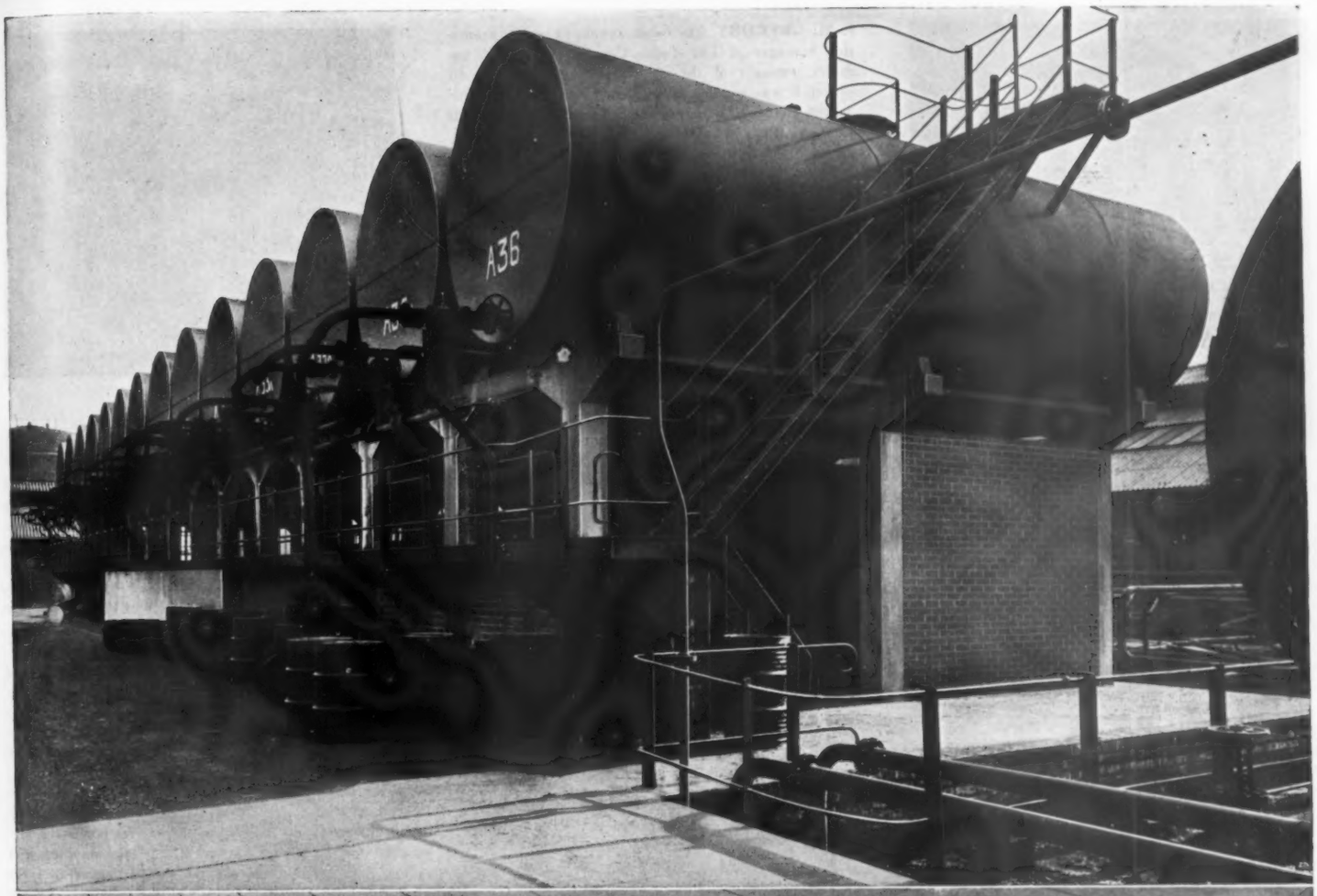
LAURENCE ANDREW has been appointed manager of the pipeline department of General Petroleum Corp., according to an announcement by George Supple, vice president. Other changes in the department include the appointment of V. C. Larsen as general superintendent and H. T. Williams as northern division superintendent at Taft, Calif. C. W. House becomes southern division superintendent, Vernon, Calif. Mr. Andrew has been with General Petroleum since 1912 and has spent the entire period in the pipeline department. His most recent post was as general superintendent. Mr. Larsen joined the company in 1919 as a truck driver. Since 1940 he has held the post of northern division manager and assistant general superintendent successively.

H. W. RIGTERINK, formerly sales manager, has been appointed general manager of the liquefied petroleum gas department of Sun Oil Co. He succeeds William H. Bateman who resigned to devote his entire time to the presidency of Martin & Schwartz Inc., manufacturer of gasoline pumps for service stations. Mr. Bateman headed the Solgas organization for about 15 years and has served as president of Martin & Schwartz since 1938. Joseph C. Fletcher, chief engineer of Solgas since 1945, is the department's new sales manager.

HAROLD DECKER formerly vice president and general manager of Pan American Production Co. and a director and officer of Pan American Gas Co., has been elected president and director of Houston Oil Co. and Houston Pipe Line Co. to succeed the late George A. Hill Jr.

Mr. Decker attended Kenyon College and the University of Oklahoma, majoring in petroleum engineering at the latter institution. He entered the oil business in 1925 in the employ of Rio Bravo Oil Co. Subsequently he became a district superintendent for Seaboard Oil Co., and in 1945 he joined Pan American Production Co. as assistant manager and in 1947 was elected vice president. He is active in oil industry affairs, being a member of the American Petroleum Institute and a director of the American Assn. of Mining and Metallurgical Engineers.

Harold Decker



OXLEY

WELDED STORAGE TANKS

A close-up view of a battery of fourteen welded storage tanks each 9′0″ diameter by 30′0″ long with connecting platforms and access staircases. Erected and installed by Oxley at Ellesmere Port, Cheshire, England, for Lobitos Oilfields Ltd., who gave permission for this photograph to be taken.

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RB W96

J. V. Doll

Doll Joins Mack-International

J. V. Doll has joined Mack-International Motor Truck Corp. as vice president, fleet sales, and as special assistant to H. W. Dodge, executive vice president. For the past twenty years Mr. Doll has been with The Texas Co. as manager of its national sales division.

Mr. Doll is one of the pioneers in the automotive field. After serving overseas as Major in World War I, he joined the White Motor Company as a salesman in Atlanta and sold the first bus in the South. Later as a member of the executive staff, he organized and headed the White Company's national sales department in Cleveland.

Graver Appoints Ad Manager

Graver Tank & Mfg. Co. Inc., East Chicago, Ind., has appointed Robert F. Millett as advertising manager. Formerly Mr. Millett was in charge of midwestern advertising for the Cities Service Oil Co. (Del.) as assistant to the general sales manager.

Curl Promoted by Youngstown Sheet

Roy A. Curl has been appointed manager of The Youngstown Sheet and Tube Company's sales promotion department, succeeding Myron S. Curtis who recently was appointed assistant to the president. Mr. Curl joined The Youngstown Sheet and Tube Company in 1924 and for the last 15 years has been assistant to the sales promotion manager.

G. FRICK POE, Houston division superintendent of production for Ohio Oil Co., has been appointed general superintendent of the production department and will be located in the company's general office at Findlay, Ohio. He succeeds Fred E. Smith, recently named assistant manager of the company's production department. O. V. Henry, Casper, Wyo., division superintendent, succeeds Mr. Poe at Houston. M. J. "Mike" Boyce, district superintendent of the Montana and northern Wyoming district, is promoted to Casper division superintendent; and R. W. McCanne, Casper division geologist, is transferred to Findlay as assistant to the manager of production.

WILLIAM B. HARPER, well-known petroleum economist, has joined the New York staff of the American Petroleum Institute as director of research. Mr. Harper comes to the API after six years' experience with the National Industrial Conference Board as petroleum economist and business analyst. During these years he founded the Petroleum Almanac and wrote many articles for the Conference Board Business Record.

JOHN F. WALTON JR. resigned as a general sales manager of the Gulf Oil Corp. March 1 to become associated with T. Mellon and Sons of Pittsburgh, to whose board he was recently elected. Mr. Walton joined Gulf as a member of the fuel oil sales department in 1940.

J. M. GREGORY has been appointed sales promotion manager of The Texas Co. and W. J. Ray becomes manager of the company's national sales division, it was announced by R. L. Saunders, vice president in charge of domestic sales. Mr. Gregory succeeds J. K. Skillings who retired Feb. 1, and Mr. Ray replaces J. V. Doll, resigned.

HOWARD T. CONREY has been appointed manager of the domestic distributor sales and service division of Continental Motors Corp. with headquarters in Muskegon, Mich. A. S. Bolthouse continues in the corresponding export post. C. Wheeler Johnson, vice president in charge of distributor sales and service, and of advertising, has overall direction of domestic and export divisions.

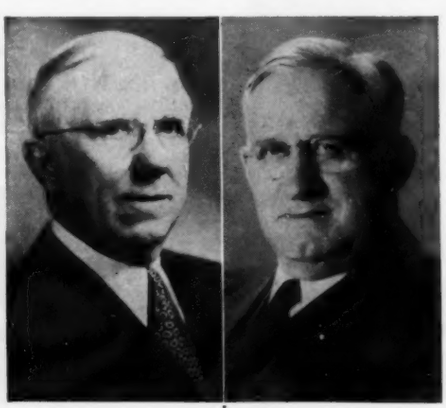
WILLIAM R. BOYD JR. was honored by his neighbors on January 18 when he returned to his ranch near Teague, Texas, after retiring as president of the American Petroleum Institute. "Bill Boyd Day" at Teague, sponsored by the Teague Citizens Council, began with the spudding of a test well on the farm by Lone Star Gas Co. and closed with a banquet at the Teague high school at which addresses were made by many notables, including W. Alton Jones, chairman of the board of the API, and Senator Tom Connally.

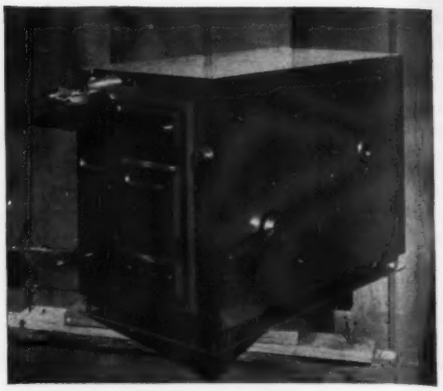
WM. A. SLATER and HERBERT HENDERSON retired as vice presidents of Gulf Oil Corp. on Dec. 31. Each has 42 years of service to his credit. Other year-end retirements announced are those of Messrs. E. E. Appel, manager of the Gulf building department and an employee for 41 years; J. G. Glasgow, manager of engineering and construction for the manufacturing department, who has been with the company for 40 years; H. E. Gibson, manager of engineering and construction for the sales department and a veteran of 33 years; and W. V. C. Bulkeley, an assistant general manager of the sales department and an employee for 21 years. All six men have been stationed in Pittsburgh.

Mr. Slater initially was employed by Gulf as a chemist at its Port Arthur, Texas, plant in 1907. In 1929 he was promoted to general superintendent of Gulf's three refineries in Texas. He was transferred to Pittsburgh as general manager of refineries in 1935. Four years later he was elected a vice president of the Gulf Oil Corp. and the Gulf Refining Co. and was placed in charge of the manufacturing and marine departments.

Mr. Henderson joined Gulf in 1907 as superintendent of construction at the company's refinery in Port Arthur. In 1928 he was transferred to Pittsburgh and in 1933 was appointed manager of the engineering and construction department which was organized to serve the company's manufacturing and sales organizations.

Left to right: Herbert Henderson, Wm. A. Slater.





The Geo-Logger

A New Aid to Exploration

A portable electric well-logging unit for shot and core holes of fifteen hundred feet or less has been developed by Geotronic Laboratories Inc. of Dallas, Texas. It has been named the "Geo-Logger" and is available for sale or lease. The logger has undergone tests in several parts of the United States and Canada, and the reaction of geologists and geophysicists who have seen it in operation has been very favorable.

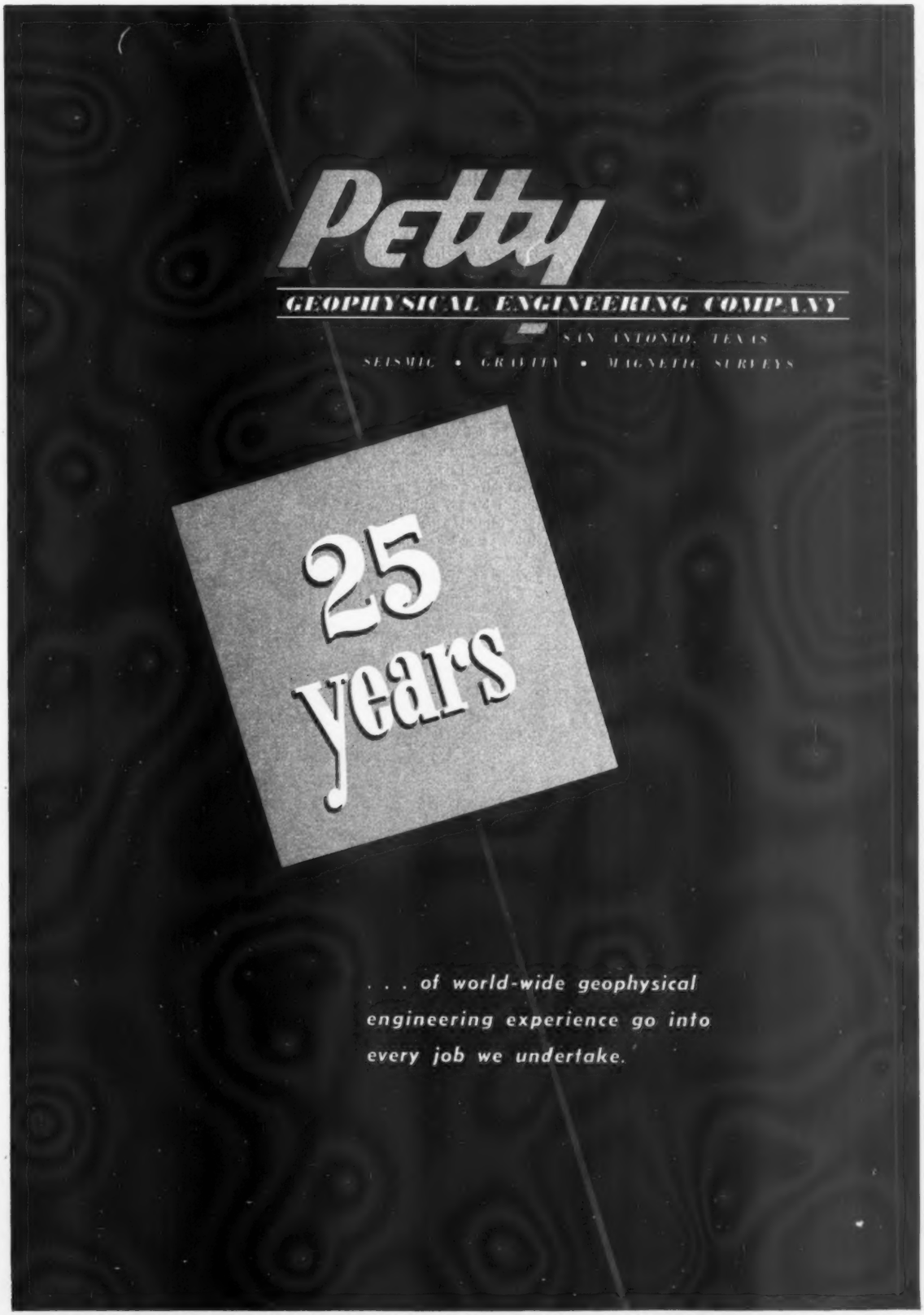
The "Geo-Logger" makes standard resistance and self-potential recordings simultaneously. The recorder is a completely new development combining ruggedness and simplicity. The entire outfit—recorder, drawworks and all—is a self-contained, weather-resistant unit, which can be mounted on any vehicle or carried in the luggage compartment of a passenger car. Any man on a drill or seismic crew can operate it, and it provides obvious economies in time and cost for logging core holes and strat tests. The logs obtained with the "Geo-Logger" on core holes have proved in every case to be virtually identical in sensitivity correlatability of anomalies, accuracy and general appearance to those obtained with any other electric logger.

For seismograph work the "Geo-Logger" provides for the first time a practical unit for the electrical logging of shot holes. Requiring neither a separate vehicle nor a trained operator, it adds very little to the cost of a seismograph survey. The brief time—less than five minutes—needed to "Geo-Log" a hole after it is drilled and to get out of the shooting crew's way will in no way slow down the normal operations of the crew. The value of resistance and self-potential logs on shot holes for accurate charge placement, subsurface correlation and water reservoir location has long been recognized, but lack of a fast, simple and reliable electrical logger has hitherto limited widespread application of the technique. The "Geo-Logger" is housed in a single aluminum case, 18 inches high, 26 inches long, 14 inches wide and weighing (depending upon the amount of wire use) an average of 130 pounds.

Heads Graver Alloy Sales

Graver Tank & Mfg. Co. Inc., East Chicago, Ind., has announced the appointment of Harry A. Dennis as manager of sales for the company's stainless and alloy steels division. He will also continue his present assignment as manager of Weldment sales. Prior to his association with Graver, Mr. Dennis was assistant district manager of sales for Lukens Steel Company and their byproducts and Lukenweld divisions.

L. W. ALBERTS has been made manager of the new synthetic fuels and chemicals department of Blaw Knox Co., Pittsburgh. Mr. Alberts was a pioneer in the development and operation of the Fischer-Tropsch plants in Germany and served as a director of Ruhrchemie since 1929. Since coming to the United States, Mr. Alberts spent two years as a consulting engineer with the Bureau of Mines experimental station at Bruceton, Pa.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. . . of world-wide geophysical engineering experience go into every job we undertake.

William M. Turnley

Organize Canadian Company

Ethyl Antiknock Ltd. has been organized as a subsidiary of Ethyl Corp. to handle sales of Ethyl fluid in Canada. Headquarters will be in Toronto. William M. Turnley has been elected a vice president of the new company. He is to be its administrative head, supervising the activities of six field men. Mr. Turnley has handled Ethyl's Canadian interests, since he joined the company 18 years ago. He first went to Canada in 1908 as a sales engineer for Western Electric Co.

Book Review

The Economics of United States and World Oil, by E. Ospina-Racines; published 1950 by the author at Apartado Aereo 49-45, Bogota, Colombia; 160 large mimeographed pages; limited edition; $25 per copy.

With more than 50 statistical tables and 34 printed graphs, the author outlines the basic economic factors governing oil supply, demand, price and time lag of the United States oil industry, and the special factors in countries abroad that will control and govern the future development of the world oil industry. The treatment covers the existing circumstances of oil supply and demand with special reference to world demand and crude oil price, the developing oil supply abroad, governnmental oil policies, together with statistics of United States and international oil operations. An important feature of the work is a searching analysis of the economic incentive that must be present in the Carribbean and Middle East regions to warrant exploration and development of oil fields in those countries. The relation here shown between production potentials on the one hand and the amount of capital which may reasonably be risked will, no doubt, be of interest to investors.

Oil Dividends Higher in 1949

While earnings of 30 U. S. oil companies in 1950 are expected to be less than in 1949, their cash requirements for capital expenditures likewise will be lower, thus enabling them to maintain present dividend rates fairly well, according to Joseph E. Pogue and Frederick G. Coqueron of the Chase National Bank's petroleum department. Despite a drop in income of $526 million or 28 percent in 1949, the 30 oil companies, which comprise two-thirds of the industry, were able to increase dividends by $87 million or 18.5 percent over 1948 because capital expenditures were lower by some $279 million or 10.8 percent.

Dividends in percent of net income for the 30 oil companies rose to 41.3 percent in 1949 from an extremely low ratio of 25.1 percent in 1948 when capital requirements were at a maximum. According to Mr. Pogue and Mr. Coqueron, the petroleum industry was able to pay its stockholders a larger percentage of net income in 1949 and still maintain a high rate of capital formation.

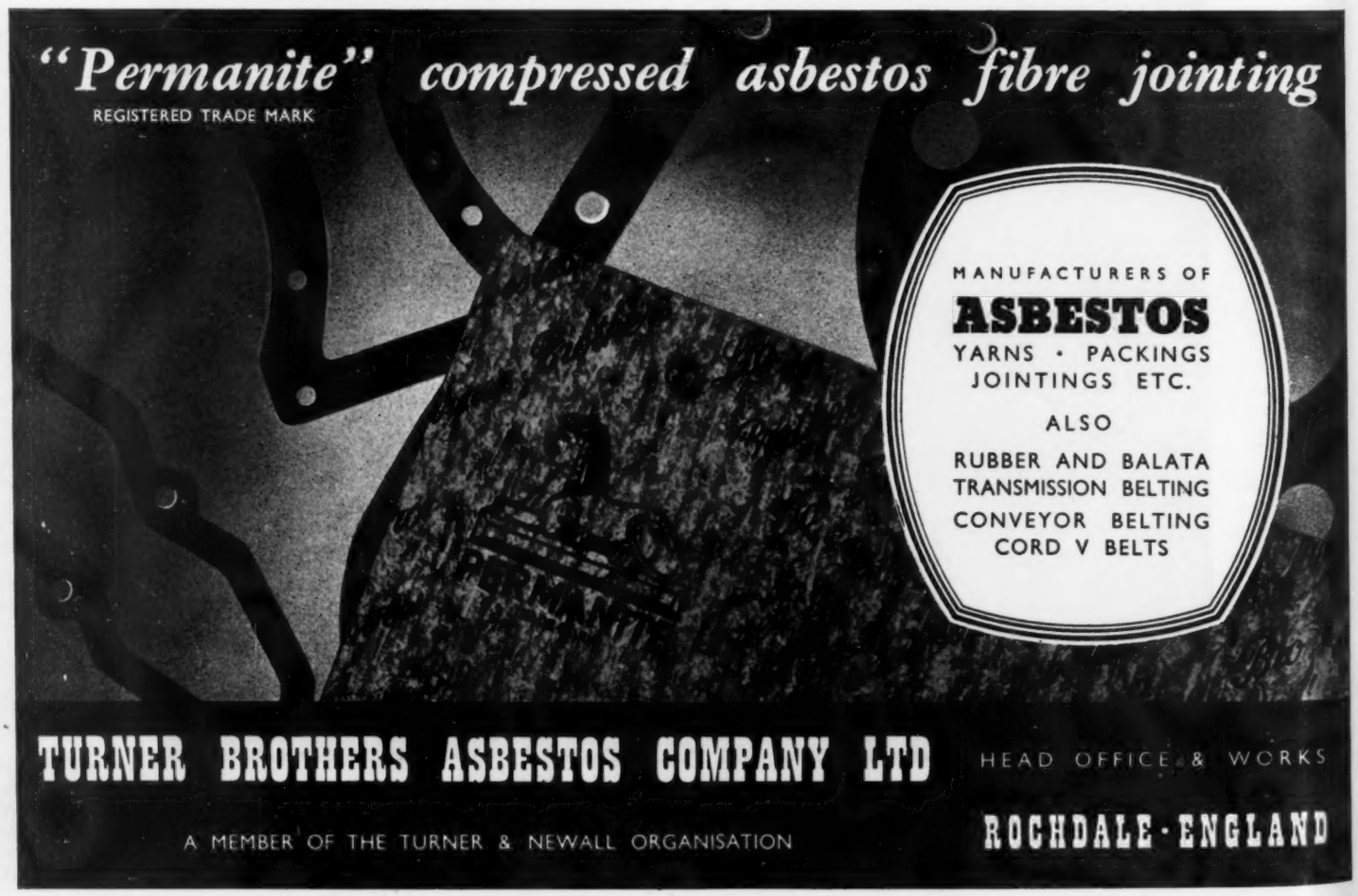
The combined financing transactions by 48 oil companies amounted to $868 million compared to $1,167 in 1948, a reduction of $299 million. Of the outside capital secured during the past year, 97.1 percent was borrowed and 2.9 percent came from common stock. None was raised by the sale of preferred stock. The money borrowed amounted to $843 million and was obtained as follows: insurance companies, 56 percent; public investors and others, 24.5 percent; banks 19.5 percent. About two-thirds of the aggregate bank loans were provided by the New York banks.

FINANCIAL DATA OF 30 OIL COMPANIES

	Actual 1948	Estimate 1949	Change 1949 from 1948
	— Million Dollars —		Percent
Earnings	1,877	1,351	—28.0
Cash Dividends Declared	471	558	+18.5
Dividends in Percent of Earnings	25.1	41.3	.....
Capital Expenditures	2,591	2,312	—10.8

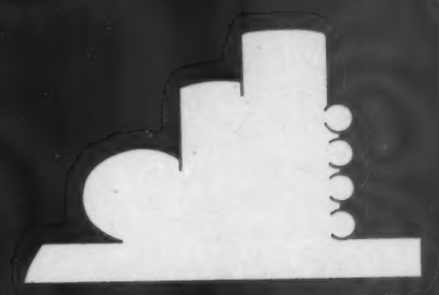
Hard-Facing Booklet in Spanish

Stoody Company has published a Spanish-English edition of its booklet entitled "Oil Field Applications of Stoody Hard-Facing Alloys," a manual covering the common uses of hard metals on drilling equipment. Copies are available upon request to Stoody Co. and may also be had from National Supply Export Corp., distributor in foreign oil fields for Stoody alloys.



increased thru-put
decreased costs
higher net earnings

the "break-thru"



revamping

modernization

Many refiners planning a "break-thru" on to a higher profit level are utilizing Foster Wheeler's complete engineering and construction service for revamping older units and installing new supplementary units.

Foster Wheeler has recently completed the revamping of several direct fired heaters, a large three-stage crude distillation unit, an old continuous crude battery, and is currently revamping and modernizing the gasoline production facilities of a large refinery including the replacement of Houdry cracking cases with a 15,000 bbl/day gas-lift Thermafor catalytic cracking section.

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process units
petroleum refineries
chemical plants

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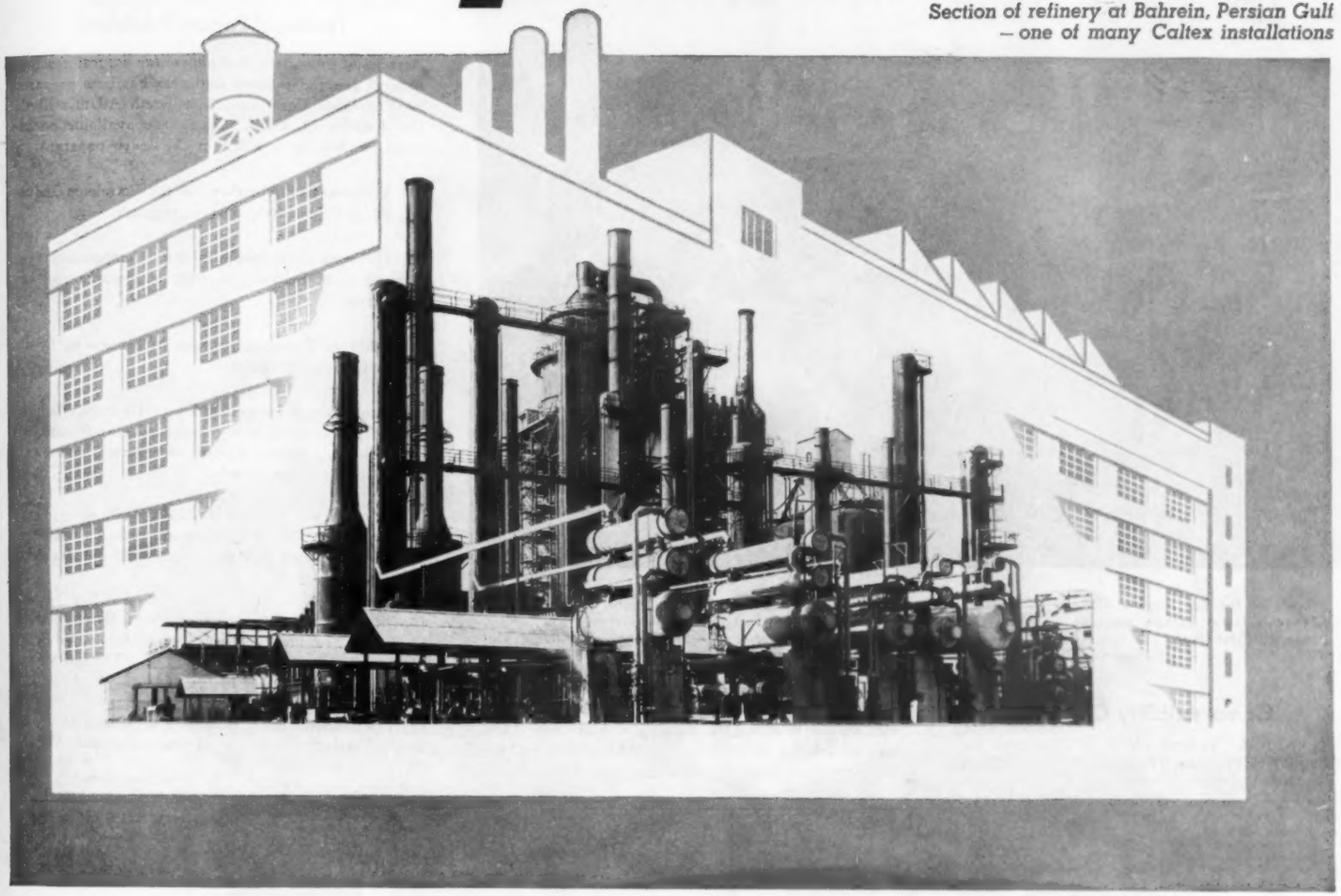
Oil is *power*...

Section of refinery at Bahrein, Persian Gulf — one of many Caltex installations



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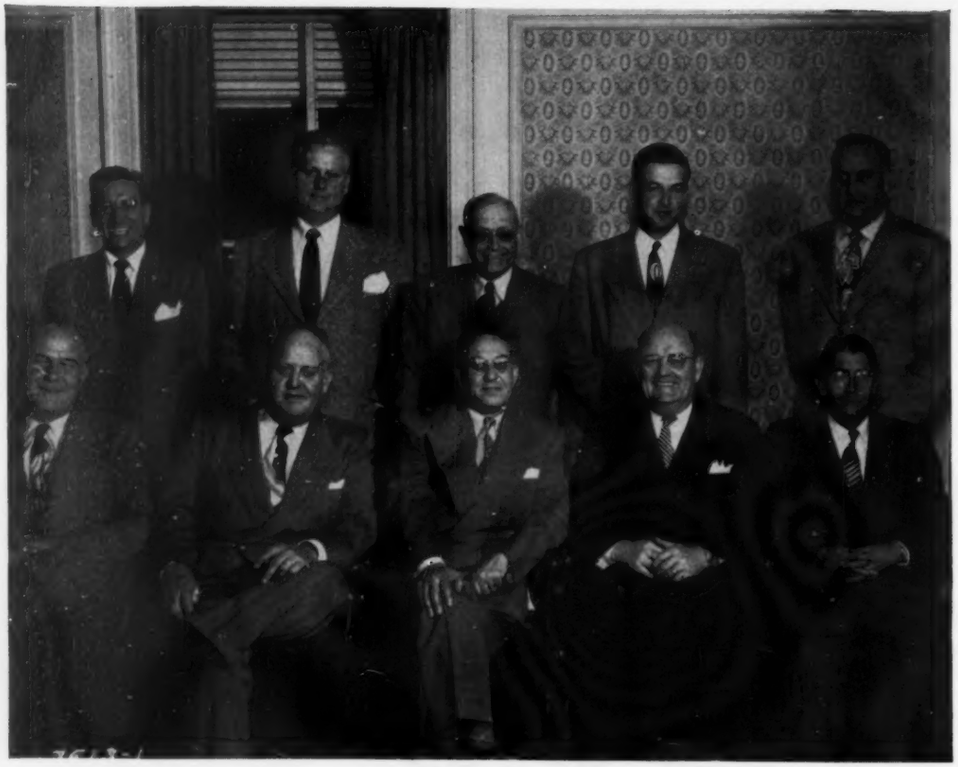


New officers of the Los Angeles Chapter of Nomads elected to serve in 1950 are left to right, (seated): Fred Ripley, regent; Herm Pachall, assistant secretary; Earle Boggass, president; Ted Forsyth, vice president; Knight Templeton, treasurer; (Standing): Lee Laird, regent; James Hughes, deputy sergeant-at-arms; Jack Ballagh, secretary; John Flanagan, assistant treasurer; and Jerry Engstrand, sergeant-at-arms.

Compressibility Charts

Under the title, "Compressibility Charts and their Applications to Problems Involving Pressure-Volume-Energy Relations for Real Gases," the research laboratory of the Worthington Pump and Machinery Corp. has published a series of new charts covering the very broad pressure-temperature range usually encountered in engineering practice, especially at low values of reduced pressure. These charts should be of interest to petroleum engineers concerned with the handling of gas mixtures for which only some of the thermodynamic properties are known.

Technical Papers Published

A series of seven technical papers for natural gasoline, natural gas and refinery engineers has been prepared by The Fluor Corp. Ltd., 2500 South Atlantic Blvd., Los Angeles 22, Calif. Copies are available on request. Following is a list of the seven papers:

(1) Fractionating Absorbers in the Petroleum Industry, by J. C. Hannah, process engineer.

(2) Pulsation Phenomena in Gas Compression Systems, by I. C. Bechtold, director of research and development.

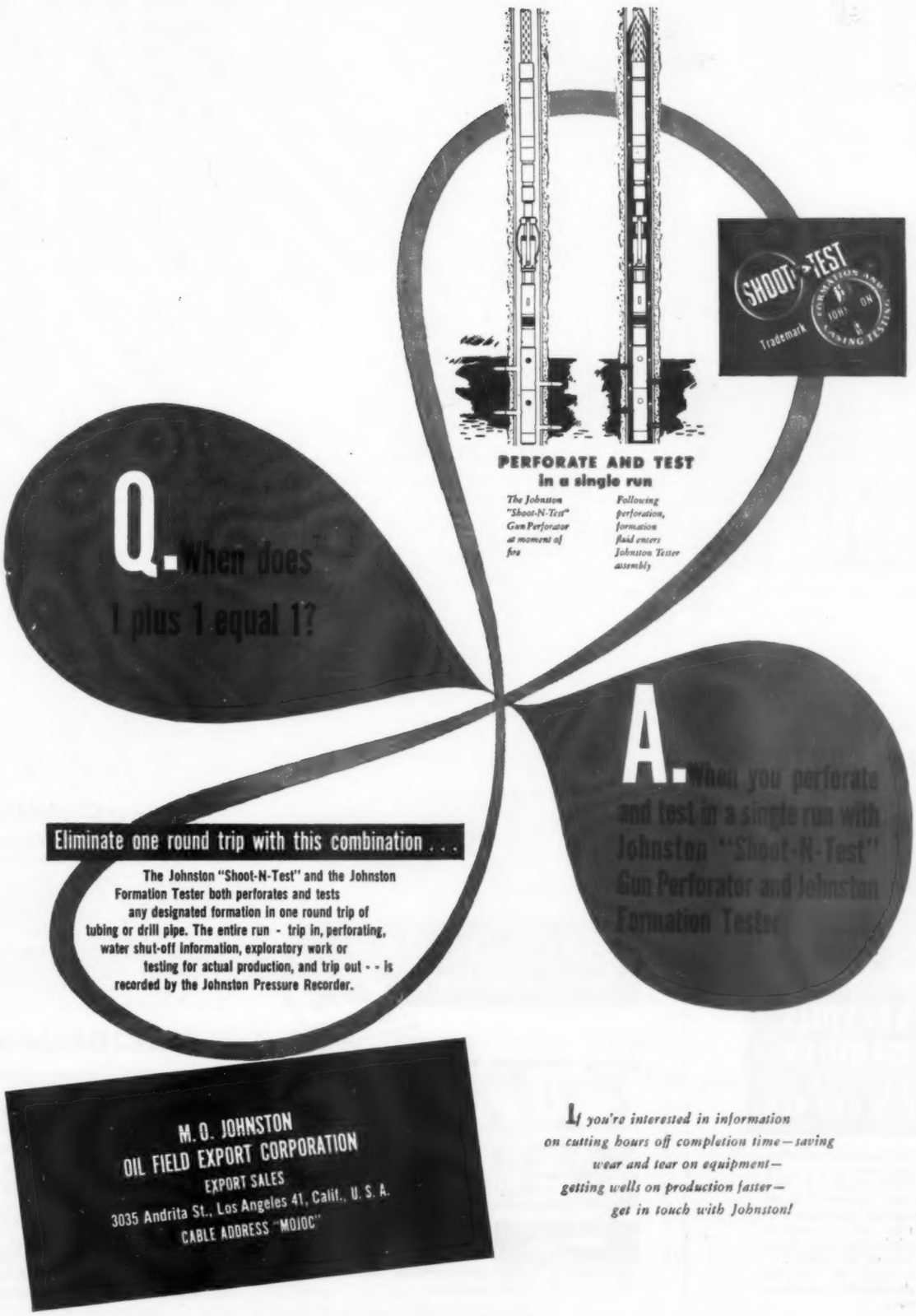
(3) Effect of Pulsation on Gas Measurement, by C. F. Yates, research engineer.

(4) Simultaneous Determination of Hydrogen Sulfide and Carbon Dioxide in a Continuous Gas Stream, by C. L. Blohm, assistant director of research, and F. C. Riesenfeld, research chemist.

(5) Mechanical Vibration of Piping Induced by Gas-Pressure Pulsations, by R. C. Baird, research engineer, and I. C. Bechtold, director of research and development.

(6) A Critical Analysis of Methods of Determination of Water Dew Point in Hydrocarbon Gases, by F. C. Riesenfeld, research chemist, and H. D. Frazier, research chemical engineer.

(7) Purification and Dehydration of Gases, by C. L. Blohm, assistant director of research, and W. F. Chapin, process engineer.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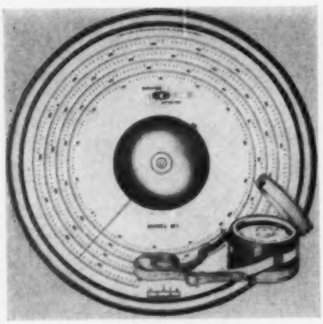

The Micro-Altimeter

New Micro-Surveying Altimeter

The first MICRO-altimeter ever made has just been announced by American Paulin System, Los Angeles, California. Graduated in intervals of one foot over a range of 6,000 feet, this instrument is accurate to one foot and sensitive to altitude changes in inches. Geologists, surveyors and field engineers can now run surveys with this easily portable instrument (weighs only 4½ pounds) in one-tenth the time consumed in ordinary surveys and with an accuracy and dependability hitherto unknown in this type of instrument work.

Model M-1 is the first of the new MICRO series available and will shortly be supplemented by model M-5 with a range of 15,000 feet graduated in intervals of five feet and also model MM-1 with a range of 5,000 meters graduated in intervals of one meter. All models are encased in a rugged leather carrying case with hand and shoulder straps. Included with each instrument is a magnifier, thermometer and full operational procedures.

Oceco Moves to Chicago

The Pettibone Mulliken Corp., a 70-year-old Chicago concern, has purchased The Johnston & Jennings Co. of Cleveland, including its Oceco division, vent valves, flame arrestors, gauges, swing lines and other tank equipment. George Fox, sales manager, and certain key engineering and production personnel have been moved to Chicago. Sales representation continues practically unchanged. The company will be known as The Johnston & Jennings Co., division of Pettibone Mulliken Corp. The new address is 4710 West Division Street, Chicago 51, Ill.

New Chemicals

American Cyanamid Co. has published "Collective Volume I," a compilation of data on several new chemicals which have become available from the company's research laboratories during the last year. Copies of the bulletin are available upon written request to the New Products Development Department, American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

API Safety Division to Move

The American Petroleum Institute department of safety will be transferred from Washington, D. C., to general headquarters of the institute at New York. All other divisions will remain at their present locations, the board of directors has decided.

THOMAS R. SHUGART, formerly vice president of Geotechnical Service Corp., has opened offices as geophysical consultant, specializing in seismic interpretations and in seismic supervision. His new offices are at 1520 Mercantile Securities Building, Dallas.

Dallas-Fort Worth Nomads Elect Officers

At the January meeting of the Dallas-Fort Worth Chapter of Nomads officers were elected for 1950: president, A. J. Olson; vice president, K. W. Davis; secretary, C. J. Berlin; assistant secretary, E. F. Shiels; treasurer, E. J. Whetzle; assistant treasurer, R. E. Todd; sergeant-at-arms, J. E. Everroad; assistant sergeant-at-arms, J. M. Bridges. Regents for 1950 are Brad Mills and J. C. Baseheart.

Committee chairmen appointed at the January meeting are: entertainment, J. E. Everroad; co-chairman, J. M. Bridges; membership committee chairman, J. E. Jonsson; visitors committee, K. Marshall Fagin; auditing, H. C. Otis; official photographer, S. M. Webster; and publicity, E. J. Whetzle.

Nomad representatives in outlying areas assisting in membership and attendance at the meetings are: Wichita Falls area, Lewis Foster; Shreveport area, Park Myers; Weatherford area, Jess Hall Jr.

Dresser To Move to Dallas

General offices of Dresser Industries Inc. will be moved from Cleveland, Ohio, to Dallas, Texas, about May 1, according to an announcement by H. N. Mallon, president. While the company's operations are international in scope, Mr. Mallon said, "We feel that it is vital to get as close as possible to what is now our largest market."

Net earnings of the company in the fiscal year ended Oct. 31, 1949, were reported recently at $3,525,182 on net sales of $80,629,805. This is equivalent to $3.02 per share of common stock. In the previous year earnings were $8,038,422 on net sales of $108,636,897. The figures are not comparable, however, due to a sale of certain companies during the year, and recently Dresser purchased Magnet Cove Barium Corp.

Fluor Adding Engineering Building

As part of the Los Angeles main plant expansion program, The Fluor Corp. Ltd., engineers, constructors and manufacturers for the oil, gas, chemical and allied industries, has started work on a new engineering building. The structure is a part of the modernizing plans at the 27-acre plant.

Canadian Oil Men Hold Meeting

The annual meeting and first annual dinner of the Western Canada Petroleum Association was held at Calgary, Alberta, on February 7. Over 500 oil men and guests from all parts of the world were in attendance. Hon. Stuart Garson, K.C., minister of justice of the Canadian government, was guest speaker, and the response to his address was made by Hon. N. E. Tanner, minister of mines and minerals of the Alberta government. Membership of the association has increased from 60 to 253 in the past year.

Lakhra Test Finds Salt Water

The Burmah Oil Company's Lakhra test well encountered large volumes of salt water under extreme pressure at a depth of 12,666 feet on Jan. 28. The temperature of this water is just below boiling point. At the producing horizon the pressure exceeds 12,000 psi and even at the surface is such that the flow is largely atomized. There is no showing of oil or gas.

Burmah Oil Co. (Pakistan Concessions) Ltd. began drilling operations at the Lakhra test well in the Sind desert on May 24, 1948. The test well reached and passed a depth of 12,000 feet on Jan. 7, 1950, thus becoming one of the deepest test wells in Asia.

New Motor Oil

Continental Oil Co. recently introduced a new additive-treated motor oil on which the company has conducted two years of research, including heavy-duty road tests with six passenger cars and four trucks.

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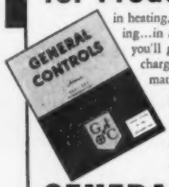

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Shell Suspends Ecuadorean Work

Shell Oil Co. of Ecuador is considering the abandonment of its exploratory campaign in eastern Ecuador after spending nearly $40 million without significant results. Operations are being suspended except in the case of a few drilling wells in Villano and Macuma which should be completed within the next six months. If results of these wells also are negative, the company plans to abandon its concessions and withdraw completely from the country. Announcement of this decision was made by John Loudon, general manager, in an interview at Quito on Jan. 27.

Shell has been exploring the jungle region east of the Andes near the headwaters of the Amazon River for about five years. The work has been carried on under great difficulties because all equipment, personnel and supplies had to be flown in from the base at Shell Mera to landing strips hacked out of the jungle. Standard Oil Co. (N. J.) joined the enterprise at the end of 1948 as a 50-percent partner.

Despite the numerous oil seepages in the territory, commercial production has not been encountered in wells drilled at Cangaime, Oglan and Tiputini. One test was drilled to almost 10,000 feet.

Package Steam Generators

Foster Wheeler Corp., New York, has published a booklet describing in detail its package steam generators. These units are factory-assembled and ready for convenient transportation by truck, rail or ship. Once at destination, the compact units are easily put into service because installation procedure is limited for the most part to service connections. Provision is made for installation of superheaters, heat recovery equipment, dust collectors and combustion controls. Copies of the booklet are available on request.

Canadian Refinery Contract Awarded

Canadian Kellogg Ltd. has been awarded a contract by Imperial Oil Ltd. for engineering and constructing a complete new refinery in Winnipeg, Manitoba, it was announced by the parent firm, The M. W. Kellogg Co. The refinery will have a capacity of 12,000 barrels per day and is scheduled for completion by May 1951. The new plant will more than double the refining capacity of the province of Manitoba, whose three existing refineries total 5,300 barrels per day. It is one of six completely new refineries or overall modernizations that Kellogg is presently either constructing or engineering in the United States, Canada, South America and Europe.

According to Kellogg, the proposed equipment will include an atmospheric and vacuum pipestill, a fluid catalytic cracking unit, a treating plant for gasoline and middle distillates, an electric sub-station, a utility plant and all off-site facilities. Crude for the refinery will be moved either by rail or branch pipeline from a take-off point on the Interprovincial line at Gretna, Manitoba.

Withdraws Burma Support

The British government has indicated its withdrawal from the reconstruction program of the Burmah Oil Co. in Burma and has, at the same time, disclosed the fact of government interest in this project. The government statement discloses that they gave certain assurances against future losses when the rebuilding of the company's assets in this area was reviewed. It is believed that the company has spent some £8 million since it began work in 1948 and that some £2 million have been spent since the government gave its backing.

Notices are being posted in Rangoon dismissing some 2,500 workers because of the fact that conditions in Burma do not encourage any hope of normal working in the immediate future. It is believed that this move is a temporary one and that the company plans to redevelop and expand Burmese production whenever possible.

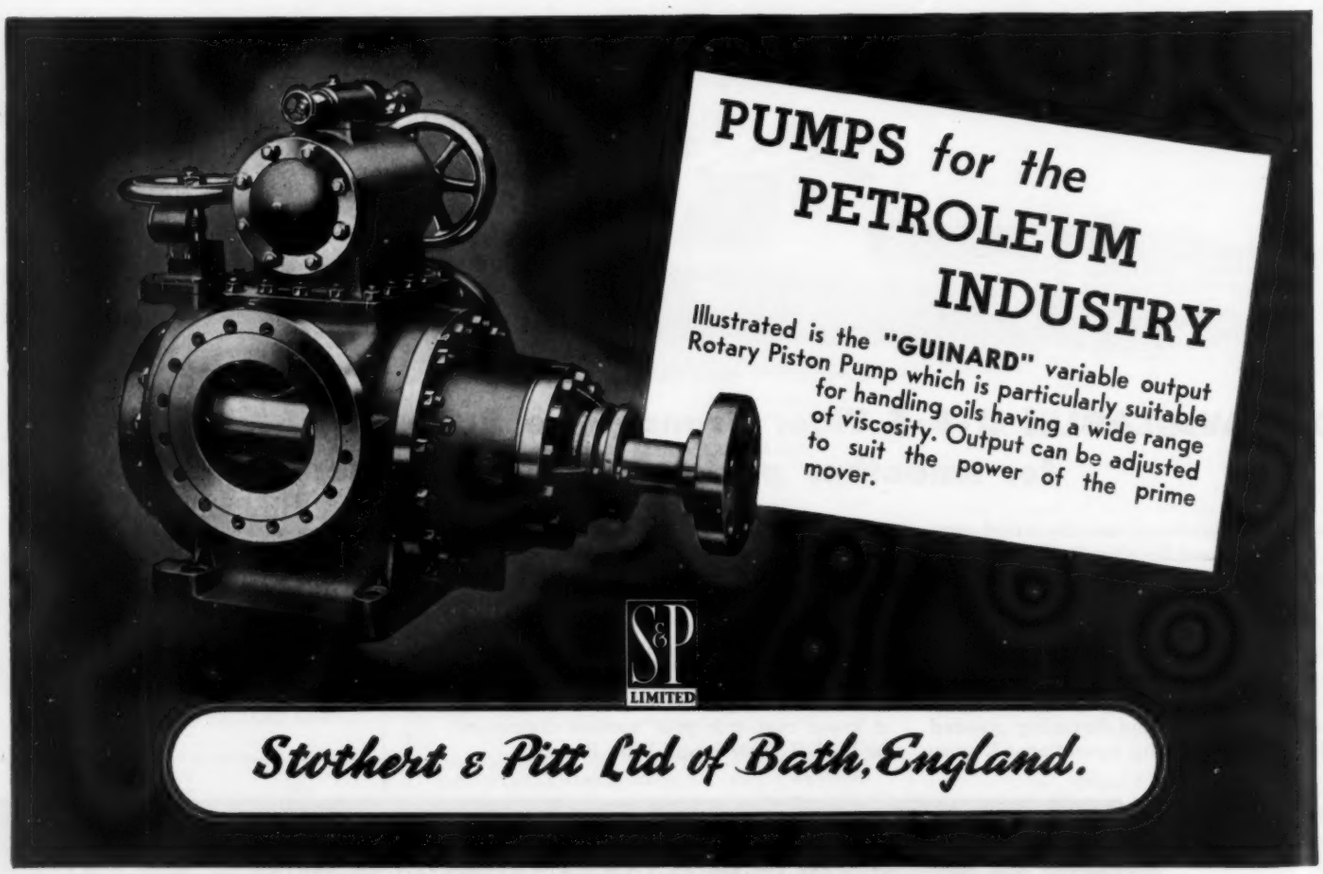
Neutral Zone Test Completed

American Independent Oil Co. has completed its first test in the Neutral Zone between Kuwait and Saudi Arabia. The test was drilled at a location some 16 miles south of the Kuwait border. Total depth was not revealed, but the operators announced that electric log correlations with Burghan field sands were obtained. Geologists have expressed the opinion that the test was on the east flank of a north-south structure. A second test will be begun at once, and geophysical work continued in the joint test program of American Independent and Pacific Western Oil Corp.

Leyland Steps Up Production

With a balance in hand of export orders worth over £2½ million and with an increase of over 25 percent in factory output to keep pace with the sales organization, Leyland Motors Ltd., Leyland, Lancs., has closed its books for 1949 showing another record in export trading. The number of vehicles exported during the twelve months is almost equivalent to the company's combined exports for 1947 and 1948.

Although production for 1949 exceeded the 1948 total by over 25 percent, the number of hourly-paid employees showed a rise of only 2.2 percent during this period. The increased output has been achieved by installing specialized machinery, re-planning of production methods, more advantageous layout of plant, and by the extensive use of machining jogs which simplify production. A new 100-hp. gasoline motor has been added to the line.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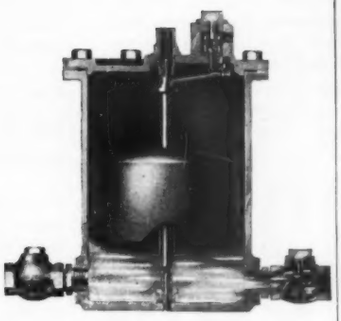

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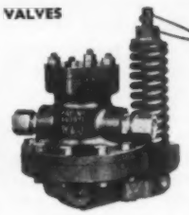

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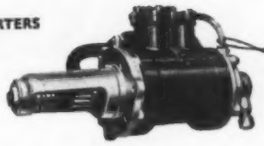

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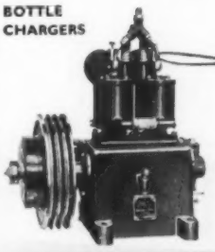

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OIL SHORTAGE THREATS ARE DISSIPATED BY RESULTS OF 1949 DRILLING

(Continued from Page 55)

The industry drilled 480 development wells in the Alberta fields in 1949, bringing the total to 1,245 with a MER of 117,000 barrels daily compared with an actual producing rate of 48,000 barrels daily. The new pipeline now being laid from Regina to the head of navigation on Lake Superior will provide an outlet for 35,000 barrels daily on an annual basis. In the open water months an average of 60-70,000 barrels daily can be transported, but this will drop to about 10,000 barrels daily in the five winter months when lake tankers cannot operate.

If the provincial government permits export of natural gas to the Pacific Northwest and to other United States consuming areas, it is expected that gas development will increase in Alberta. As noted above, there were 22 discoveries in 1949 to add to the previous list of five fields, and reserves are now calculated at seven trillion cubic feet.

R. B. Gilmore of DeGolyer and MacNaughton reviewed Latin American producing development for the AIME. He reported that Brazilian government authorities are stepping up their exploratory work in an effort to develop a domestic supply to reduce the 25.7 million barrels per year which now must be imported from other countries. Eighteen wells were drilled in 1949, of which 13 were oil wells, one gas and four dry. Extensive geophysical work has been carried on, and three areas have been selected for 1950 wildcatting.

In Chili the Spring Hill field now contains 16 wells producing out of the 29 drilled. Production is 2,000 barrels daily. First shipment of oil left this field in February for the ANCAP refinery at Montevideo, Uruguay.

Argentina may have an important new field at Coleta. Older fields are declining, and total output for the year was down about two percent.

Union Oil Co. is abandoning its search in Paraguay after five dry holes, and Shell appears about ready to leave the interior region of Ecuador after an unsuccessful wildcatting campaign. Ecuador has a coastal production of about 7,000 barrels daily. Guatemala's new oil law has discouraged any further efforts of oil companies in that country. On the other hand, Peru is considering a liberalization of its oil law to increase oil activities. Colombia recently has issued a liberalized decree law. Production in Colombia was higher in 1949, giving the country a favorable trade balance of $22 million. The country hopes to improve this by increasing the 8.5 million barrels of oil refined locally.

Venezuela with 50 active fields added eight new producing areas in 1949 and increased its reserves above the previous estimate of nine billion barrels.

E. K. Berlin, reviewing the Far East and Oceania, reported that political disturbances still kept operators from northern Sumatra and much of Java but that central Sumatra now is opening up again for rehabilitation of prewar fields. South Sumatra production rose from 69,500 barrels daily in 1948 to 91,600 barrels per day in 1949.

In southeast Borneo the Balikpapan refinery has been rebuilt, and nearby production has increased from 8,500 to 15,000 barrels daily. Production in the middle region will increase when a pipeline is completed in 1951. Production of the Seria field in the north was up to 63,000 barrels daily in 1949 from 55,000 barrels the year before.

New Guinea became a producer in 1949 at 4,800 barrels daily from Klamono. Wasian production must wait further development drilling and construction of a 60-mile pipeline through the jungle. Three wildcat rigs are running in Papua, but there have been no discoveries.

Although world consumption still is hampered by exchange difficulties resulting in import quotas and consumer rationing in many countries, and despite the second warm winter in the United States, the curve of demand continues to rise. The U. S. Bureau of Mines has estimated that total demand for oil in the United States will reach 2,305 million barrels in 1950 compared with 2,233 million barrels in 1948. Domestic demand is estimated at 2,207 million barrels compared with 2,113 million barrels, an increase of 4.45 percent.

The forecaster of oil demand now is confronted with more variables than formerly, it was pointed out in an AIME paper by Jerry A. Cogan of the Coordination and Economics Department of Standard Oil Co. (N. J.) Now that winter demand for oil is greater than in summer, the weather has become a most important element for the forecaster. And thus far no provable techniques have been developed for long-distance weather forecasting. Mr. Cogan mentioned the psychological factor as being of importance to the forecaster. He was referring particularly to the attitude for distributors who control a very large volume of storage. When the distributor neglects to buy a fair reserve stock of fuel oil in the summer months, he may very seriously affect forecasts of refinery demand. Other factors of importance are competing fuels, and recently it has been very difficult to forecast what the coal miners will or will not do. General business conditions have some effect on oil, but not as much as on most other industries.

With Mr. Cogan's explanation of difficulties in the path of the forecaster, the guess that demand in 1950 will rise between four and five percent may, of course, be somewhat wide of the mark. A cold fall and winter might change this very radically.

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To Accelerate Alaskan Operation

The Bureau of the Budget has recommended an appropriation of $11 million for development of Naval Reserve No. 4 in Alaska. Previous year's appropriation was $3 million. The Navy believes that its geological and geophysical work is far enough along to speed up actual drilling.

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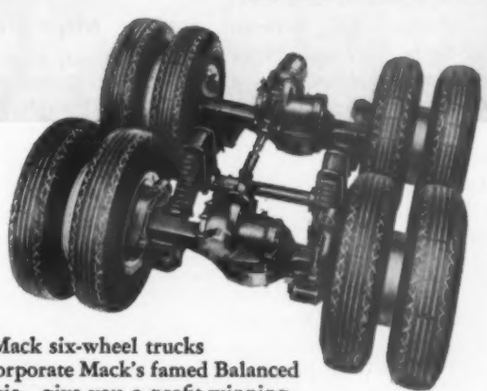

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PEMEX PLANS 300-WELL PROGRAM TO INCREASE 1950 PRODUCTION

(Continued from Page 66)

seek sales in Europe. However, he admitted that Mexico's oil exports at present are far from what they were in 1938 when the industry was nationalized with expropriation of the major foreign companies. He cited higher production in the Middle East blocking big export business by Mexico as those wells supply much of Europe as well as Asia and Africa.

Pemex apparently looks confidently to American, and perhaps other foreign, independents to further its production program. Bermudez, declaring that the Mexican oil industry is progressing satisfactorily, asserted that Pemex will reject loans that infringe Mexican sovereignty but has its doors wide open to foreign capital that respects Mexican laws. He asserted that the Pauley group, which operates in Mexico as the Mexican-American Independent Co., and some others, including Mr. Wiegand, are cooperating valuably with Pemex in full accordance with the policy he proclaimed.

Mexican-American Independent is completing its first well under the contract with Pemex, Tortuguero No. 1, Tortuguero field, between Coatzacoalcos and the Barra de Tonalá, Vera Cruz. Completion is in two sands encountered between 5,900 and 6,300 feet. The company's Mexico City office said favorable progress is being made with its second well, Xicalango No. 1, near Ciudad del Carmen, Campeche, some 180 miles southeast of the Tortuguero rigging. Drilling began early in December. It is a straight hole. Tortuguero is a directional hole, drilled from shore and extending out under the Gulf. Bermudez officially praised Mexican-American Independent for these wells. Site of Xicalango No. 1 was chosen after the geophysical examination by Geophysical Survey Inc. of Dallas, Texas, with the cooperation of chiefs of Pemex's exploration department. Because of its isolated position, a special camp had to be established. The camp includes an electric light and power plant, drinking water and sanitation services for a crew of about 100 men. The camp and the company's branch office at Coatzacoalcos, which handles field operations, and the main office in Mexico City are in instant communication by radio.

Southeastern Oil Co., represented in Mexico by Gordon Duke, with offices at Paseo de la Reforma, No. 1, Mexico City, is negotiating with Pemex for a drilling contract similar to hat granted the Pauley interests. Mr. Duke and Sen. Bermudez are holding conversations in Mexico City. Southeastern reportedly wants Mexican oil for its customers in the United States and Europe.

President Miguel Aleman has authorized Pemex to exercise control over various Gulf Coast marine tracts with strong oil indications and which are marked for drilling, by placing them under Pemex's domain. The tracts include the Barra de Santemapan, Vera Cruz; Barra del Pozo, and lands under the Laguna del Carmen, Campeche.

The oilworkers union is seeking virtual expropriation of Mexican Gulf Oil and International Petroleum by having them incorporated with Pemex. These companies, the union complains, export large amounts of oil without any control by Pemex. The union considers the operations of these companies infringe Mexican oil laws. Mexican Gulf has a terminal with refinery and wharfs at El Prieto, Vera Cruz, and operates three wells nearby. International, which has two wells, sells its production to Mexican Gulf. Both companies were excluded from the Cardenas expropriation decree of March 18, 1938. Mexican, Gulf and International workers do not belong to the oil workers union.

Ep Soluble Cutting Oil

Manchester Oil Refinery (Sales) Ltd. has developed a new soluble cutting oil with extreme pressure characteristics. The new oil, Supramor Galactol E.P. was produced to aid in the machining of difficult alloys such as nickel chrome alloys and heat resisting austenitic alloy steels which display severe work hardening and abrasive characteristics involving high specific cutting pressures.

Major George Togo Lynch

George Lynch, 45, a director of the Societe Anonyme des Huiles Castrol, died following a heart attack on Dec. 24, 1949. Mr. Lynch played an important part in developing the business of the Wakefield oil interests in France and North Africa.

The son of Charles Lynch, the famous war correspondent, he owed his unusual second name to his father's presence on board the flagship of Admiral Togo at the battle of Tsusima when the Japanese destroyed the Russjan fleet. Educated at Stoneyhurst, his business career in France proved of great value to the Allies during the last war. Following the fall of France he returned to England to join the British Forces as a private, and a year later was commissioned in the Intelligence Corps. The rest of the war he worked closely with the French Resistance and was responsible for organizing the escape routes through which many thousands of British, French and Canadian servicemen evaded capture by the enemy.

In 1948 the French government recognized Major Lynch's distinguished services by creating him a Chevalier de la Legion d'Honneur and giving him the rare award, for a foreigner, of the Croix de Guerre and a bar.

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US 36

Henry J. McAdams, newly elected president of the New York Nomads chapter, receives his gavel from James W. Reed, retiring president of the chapter. Activity program for the chapter this year includes regular dinner meetings the first Monday in March, April, September, October and November; special invitation dinner in May; golf parties in June and September, and a dinner dance in December.

Kellogram Gets New Format

The Kellogram, house publication of The M. W. Kellogg Co., oil refinery contractors and engineers, has been redesigned to include striking, full-color photographs. As part of the new treatment the Kellogram editors have extended their use of photographs to illustrate various steps in the construction of plants being discussed. The January 1950 issue features the $20 million modernization program at the East Chicago refinery of Cities Service Oil Co. The Kellogram is produced by Gordon Baird Associates, advertising and public relations specialists, under the direction of J. M. McAneny of The M. W. Kellogg Co.

Peru's Oil Production

Peru's production of crude oil in 1949 amounted to 14,796,091 barrels against 14,068,880 barrels in 1948, an increase of five percent. Output of casinghead gasoline was about 1,100,000 barrels, raising total production to roundly 15,900,000 barrels.

In the Brea Pariñas field of International Petroleum Company production rose from 11,362,498 barrels in 1948 to 11,912,964 barrels in 1949. No new fields were developed, and exploration was confined to deeper drilling which was not successful.

Compañia Petrolera Lobitos advanced its production from 2,472,969 barrels in 1948 to 2,621,779 barrels in 1949, or about six percent. Natural gasoline output was 117,439 barrels against 116,747 in 1948. Lobitos heretofore had exported its entire output, but by a new decree of the government was required to divert about 50 percent to domestic consumption at a lower selling price. Domestic demand in Peru amounted to 7,266,503 barrels in 1949 or almost 50 percent of crude production. Selling prices at the domestic market are fixed by the government and have not been essentially altered for the past 20 years, being the lowest in South America and probably in the world. The price of motor gasoline, excluding taxes, amounts only to about 2½ cents per gallon. Demand for an increase of domestic prices is still pending.

Production of the government's Empresa Petrolera Fiscal amounted to 121,153 barrels against 112,603 barrels in 1948, but the yield of the new wells in Orangos field has been low and no additional development has been undertaken so far.

Ganso Azul's production in the Amazon basin increased to 140,196 barrels in 1949 from 120,810 barrels in the former year, but consumption was restricted to the local market, as export to Brazil was interrupted by a tugboat being put out of commission.

The exploration well of the national Compañia de Petroleo El Oriente at Rio Pisqui in the Ucayali basin had to be abandoned because of stuck drill pipe, and a new hole is to be drilled.

As previously reported, a decree of the government abolished exchange restrictions and allows the oil companies to collect the whole amount of their exports in free dollar certificates. Venezuela and Peru are now the only countries in South America with free exchange.

The new oil law, providing more liberal conditions for the development of the vast unexplored areas of the country, has not been issued so far, and its postponement until the opening of Congress after the proposed elections in July presages a delay which may hamper oil development in Peru, as the general situation in the world markets appears to be getting more difficult.

Launch Super Tanker

The S. S. "Sovac Daylight" was launched at the Chester, Pa., yards of Sun Shipbuilding and Dry Dock Co. on Feb. 6 for Tankers Navigation Co. The S. S. "Sovac Daylight" is the tenth supertanker to be launched by Sun Ship. It is more than 600 feet long, 82½ feet in beam and 42½ feet in depth. The oil-carrying capacity is nearly 10 million gallons. The hull of the supertanker was laid July 21 last.

Coal to Gasoline Demonstration

The coal hydrogenation demonstration plant at Louisiana, Mo., has completed a continuous seven-week break-in run, converting coal tar oil and Wyoming coal to gasoline and other liquid fuels. It is the first time that substantial quantities of oil have been made from tar oil and coal by hydrogenation in this country. A wide variety of other coals will be tested later.

Erratum

On page 36 of the January issue of WORLD PETROLEUM it was reported that Graver Construction Co. erected part of the tank farm at the new Eagle Point works of The Texas Co. at Westville, N. J. The Graver company did not furnish any storage tanks, but designed and erected the Linde treating unit, fabricated and erected the furfural unit with its tower tanks, cooling towers and pump houses, as well as many yard facilities.

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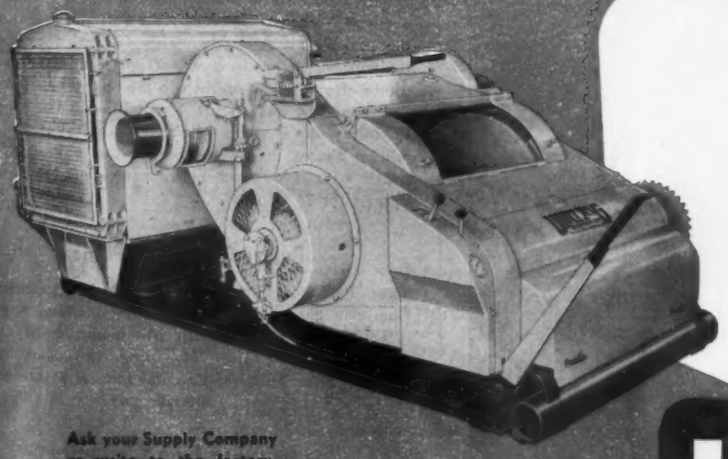

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DESIGNED FOR THE JOB...

New Arc Welders

A new line of lightweight mobile engine-driven d.c. arc welders, the WD-40 series, has been announced by General Electric welding division. The new series includes both gasoline and diesel engine models with outputs rated at 200 to 400 amps and welding ranges up to 500 amps.

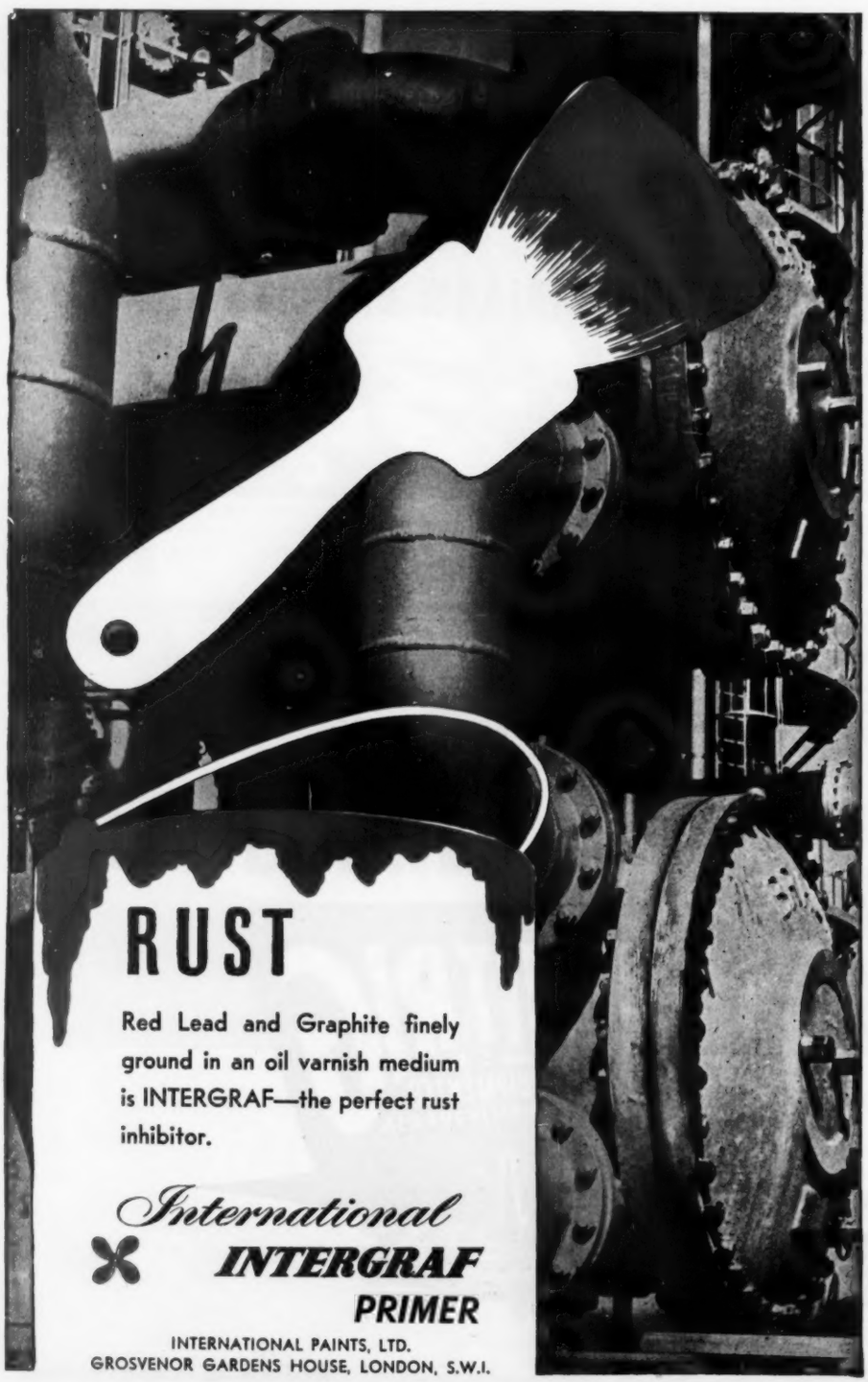
Change Information Campaign Emphasis

The 1950 campaign of the Oil Industry Information Committee will be radically changed from that conducted in 1949, it was decided at a meeting of the committee at New Orleans recently. The 1950 campaign will feature panel-type "talking pictures" to emphasize oil industry competition and resulting public benefits. A 16-mm motion picture is to be prepared for showing during Oil Progress Week next fall, which will tell the story of oil.

Guy Tate, vice president of Magnolia Petroleum Co., was elected a vice chairman of the National Oil Industry Information Committee. He is chairman of the Gulf-Southwest district committee.

New Design of Deaerating Heater

A new deaerating heater has been designed by Graver Water Conditioning Co. to reduce the oxygen content of boiler feedwater to less than .005 ml per liter, regardless of rapid load variations or unusual operating conditions. Carbon dioxide is also completely removed. In this new two-stage heater the special design of spring-loaded, self-adjusting spray valves in the first stage causes heating of the incoming water to within two to four degrees of the steam so as to remove virtually all the oxygen and free carbon dioxide. In the second stage the preheated water is intimately mixed with a large excess of incoming steam by means of specially designed scrubbing baffles, so that the major portion of the steam which remains as vapor carries with it the small traces of undissolved gases on its way to the first stage where it heats the incoming water.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Study Corrosion Resistant Equipment

British oil engineering companies are to give intensified attention to the production of corrosion resistant equipment. The Council of British Manufacturers of Petroleum Equipment of London has established a joint committee to study corrosion, on the basis that "40 percent of all the iron and steel fabricated everywhere is for the purpose of replacing metal lost by corrosion." A detailed list of special equipment required by the oil industry is in course of preparation and will be handed to the Council for transmission to such of its members as may be interested, following which it is hoped to have joint discussion between interested members and oil company representatives.

Packing Chart

Crane Packing, Ltd., of Slough, England, has published a brochure containing a chart of recommended packings for use with a large variety of liquids. Of the 36 packings, several are suitable for a good many liquids, but the company offers to make specific recommendations to users based on type of machine, valve or pump, whether reciprocating or rotary, pressures and temperatures to be encountered, speed of shaft or rod in contact with packing and condition and material of shaft. The brochure has a section devoted to proper fitting of packings. Copies are available on request.

French Oil Financing

French banks are to finance prospecting in France and overseas French possessions with a view to improving the nation's oil resources. This follows a period of limited prospecting in these territories and the expenditure of around $24 million in the past year, of which the Treasury gave some $11 million. The Society Financiere des Petroles will have a capital of Frs. 500 million shares in the company being offered to the public with a government guarantee of 3½ percent interest for 25 years.

Builds Canadian Plant

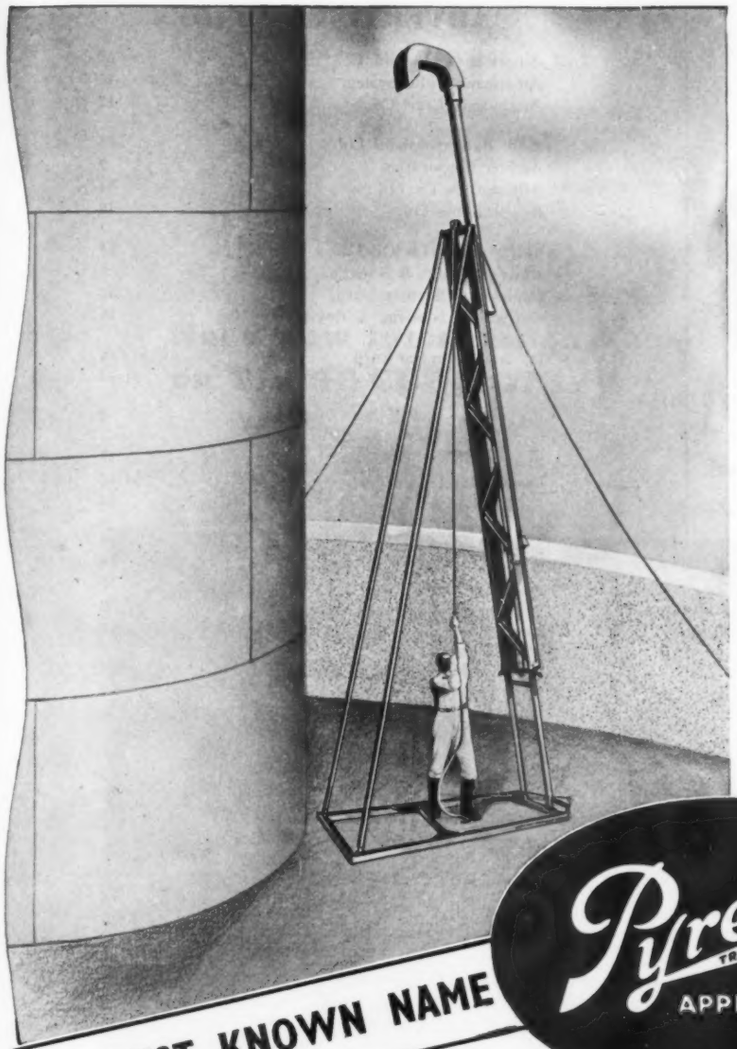
Tube Turns of Canada Ltd., which was granted its Dominion charter on Dec. 2, is establishing a plant in Chatham, Ontario, which will manufacture Tube-Turn welding fittings beginning in about three months. Tube Turns of Canada, Ltd., is a subsidiary of Tube Turns, Inc., Louisville, Ky.

To Increase Line Capacity

Capacity of the crude line from Portland, Maine, to Montreal, Canada, will be increased this year from 58,000 to 140,000 barrels daily. The line is owned by four Canadian oil companies, Imperial Oil Ltd., British American Oil Co., McColl-Frontenac Oil Co. and Shell Oil Co.

Order New Tankers

Construction of four new tankers, costing £3 million, will be undertaken in the United Kingdom. These four new 16,000-ton deadweight, diesel-engined ships are part of a group of nine ordered by Lloyd Brasileiro of Rio De Janeiro, the other five going to Swedish yards. While the orders remain to be confirmed by the purchasing organization involved, it is indicated that Lithgows Ltd. will build two; the Blythswood Shipbuilding Co. Ltd. of Scotstoun, one; and William Hamilton and Co. Ltd. of Port Glasgow, one.



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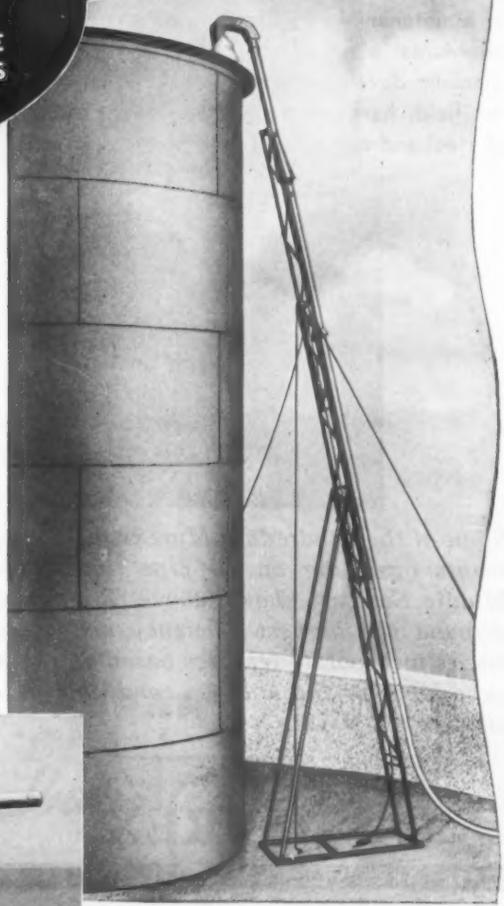

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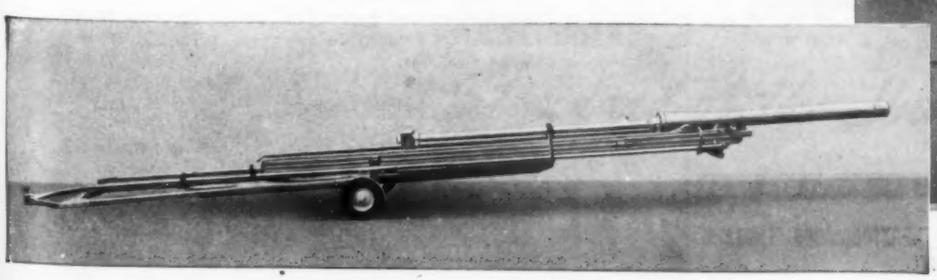

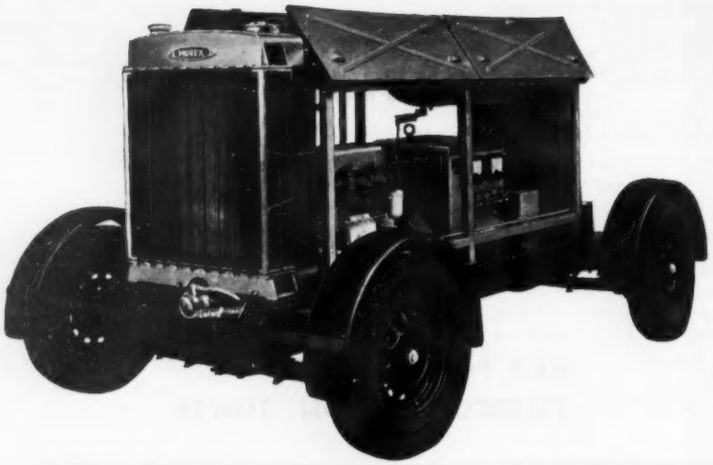

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